WORK PLAN

PHASE III REMEDIAL INVESTIGATION
INSTALLATION RESTORATION PROGRAM SITES 03 AND 09
AND
BASEWIDE TERRESTRIAL ECOLOGICAL RISK ASSESSMENT

NAVAL CONSTRUCTION BATTALION CENTER
DAVISVILLE, RHODE ISLAND

Contract No. N62472-92-D-1296
Contract Task Order No. 0032

Prepared for

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Northern Division
Naval Facilities Engineering Command
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October 1994
DRAFT
EA PROJECT 296.0032

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Nicholas A. Lanney, P.E. Date
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Program Manager

October 1994
DRAFT
EA PROJECT 296.0032

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TABLE OF CONTENTS

Page

Table of Contents (Continued)

Table of Contents (Continued)

Table of Contents (Continued)

LIST OF FIGURES AND TABLES

List of Figures

List of Tables

1.0 INTRODUCTION

1.1 AUTHORIZATION

This workplan is for a Phase III remedial investigation at Installation Restoration (IR) Program Site 03 ("Site 03"), CED Solvent Disposal Area; a Phase III remedial investigation and marine ecological risk assessment at IR Program Site 09 ("Site 09"), Allen Harbor Landfill; and to resolve ecological risk assessment issues related to the terrestrial/freshwater wetlands Ecological Risk Assessment (ERA) for the Naval Construction Battalion Center (NCBC) - Davisville, Rhode Island. This workplan has been prepared in accordance with the Scope of Work for Contract Task Order 0032 (and the Change in Scope memorandum dated 20 October 1994); Contract N62472-92-D-1296. This workplan consists of: a Field Sampling Plan (Chapter 3); Quality Assurance Project Plan (Chapter 4); Safety, Health, and Emergency Response Plan (Appendix A); and Field Sampling Procedures (Appendix B). Separate workplans for the ecological risk assessment and terrestrial risk assessments are included as Appendices C and E, respectively.

1.2 SITE LOCATION

NCBC-Davisville is located in the northeast section of the Town of North Kingstown, Rhode Island, approximately 18 miles south of the state capital, Providence. (Figure 1-1). A significant portion of NCBC Davisville is adjacent to Narragansett Bay. Adjoining NCBC Davisville's southern boundary is the decommissioned Naval Air Station (NAS) Quonset Point which was transferred by the Navy to the Rhode Island Port Authority (RIPA) in April 1973 (TRC, 1994).

IR Program Site 03 is located immediately west of Site 02, in the northern portion of NCBC Davisville (Figure 1-2). The site consists of a flat and previously paved area, bounded by Sayers Street to the east, Parade Road to the south and Battalion Boulevard to the north (Figure 1-3).

Site 09 covers an area of approximately 13.5 acres along the western side of Allen Harbor. The landfill is bounded to the east and south by Allen Harbor and to the west by Sanford Road (Figure 1-4).

1.3 REMEDIAL INVESTIGATION/ECOLOGICAL RISK ASSESSMENT OBJECTIVES

The overall objective of the remedial investigation at Site 03 is to assess whether past Navy activities in the area located west (on what is now Rhode Island Port Authority property, but prior to 1974 was Navy property) and northwest of Site 03 may have contributed to the volatile organic compounds (VOC) detected in the deep ground water west (upgradient) of Site 03 between Seabee Avenue and Sayers Street.

The objectives of the remedial investigation and ecological risk assessment at Site 09 are to

The objectives of the remedial investigation and ecological risk assessment at Site 09 are to evaluate: 1) the nature and extent of VOC in the lower portion of the upper (sand) aquifer in the vicinity of 09-MW-7D; 2) the nature of potential VOC in the deep ground water (silt unit and bedrock aquifer); 3) the impact of potential VOC in the deep ground water migrating from beneath the landfill toward, and discharging into the bottom sediment of Allen Harbor on the bottom dwelling (benthic) and near bottom dwelling (pelagic) marine organisms, and if appropriate, through the food chain; 5) the impact the bringing sediment from below the zone of bioturbation in Allen Harbor into contact with sediment in the zone of bioturbation and the water column resulting from clamming, dredging, or storm surges and 6) the ecological impact of the landfill on the salt water marsh/wetlands to the north and south of the landfill.

The objective of the resolution of the terrestrial/freshwater wetlands ecological risk assessment issues related to the NCBC are to address data gaps and problems associated with the risk assessment as identified by the U.S. EPA Region I. These issues are facility-wide in extent, incorporating the Main Center, West Davisville, and Camp Fogarty and their surrounding areas.

The purpose of this workplan is to present the tasks and procedures, (i.e., field investigation, sample analysis, data evaluation, and risk assessment), necessary to accomplish the project objectives.

Site 03 tasks include the following:

1. Install four monitoring wells to the top of bedrock upgradient of Site 03 on the RIPA property.

2. Collect split spoon soil samples as the soil borings for the monitoring wells are drilled, and screen the soil headspace for VOC using a portable gas chromatograph. Based on the headspace screening results, select two soil samples from each soil boring and submit the samples for laboratory analysis for Target Compound List (TCL) VOC.

3. Collect a ground-water sample from each of the four wells and analyze the samples for TCL VOC.

4. Measure and record the depth to the water table in each of the wells located in Sites 02 and 03.

5. Evaluate the data collected during the subsurface investigation, with regard to possible source areas, the bedrock surface configuration, and the direction of flow.

Site 09 tasks include the following:

1. Install two monitoring wells in the lower portion of the upper aquifer and one well in the silt unit in the area of 09-MW-7D to assess the nature of VOC in the ground water and whether "pooled DNAPL" is present.

2. Drill two borings into bedrock and complete them as monitoring wells. Recover rock core from and perform packer testing in the boreholes in order to estimate aquifer parameters to be used in the fate-transport model.

3. Select and analyze up to two soil samples from each test boring for laboratory analysis of TCL VOC. Sample selection will be based on soil headspace screening results using a PID.

4. Collect samples from nine wells, the five wells described in 1 and 2 above, as well as 09-MW-6D, 09-MW-8D, 09-MW-9D and 09-MW-10, and analyze the samples for TCL VOC.

5. Monitor fluctuations in the elevation of the water table and changes in salinity over several tidal cycles to aid in the evaluation of the hydraulic relationship between the aquifers which underlie the site.

6. Collect samples of sediment at each wetlands sampling station (Figure 3-3), (the top 2 cm of sediment) for sediment toxicity bioassays (using *Ampelisca* or other appropriate amphipod species), pore water toxicity tests (using *Arbacia*), SEM/AVS analysis, grain size and TOC determinations, and bulk chemistry analysis.

   Collect sediment cores (approximately 1-2 M in length) at the wetland and Allen Harbor sampling stations (Figure 3-3). Scan each replicate core for magnetic susceptibility to determine the representative core (for each sampling station) to be selected for analysis of bulk metals, PAH, PCB, pesticides, and butyltins, grain size, and total organic carbon.

7. Perform fate-transport modeling of VOC in the bedrock.

8. Perform an ecological risk assessment of deep sediment in Allen Harbor.

9. Prepare remedial investigation and ecological risk assessment reports.

Facility-wide tasks for the terrestrial/ecological ERA include the following:

1. Collect and analyze additional biological and chemical samples in the freshwater wetlands in the study area's five watersheds.

2. Revise and expand the ecological risk assessment to incorporate the results of these additional samples.

3. Revise the ecological risk assessment to address EPA's comments concerning inadequacies in the approach and in the data presentation of the draft final ERA prepared by TRC.

1.4 KEY PERSONNEL AND RESPONSIBILITIES

Figure 1-5 is the CTO organization chart. The following are summaries of responsibilities and pertinent qualifications of the key personnel assigned to this CTO.

1.4.1 CTO/RI Task Manager - Nicholas A. Lanney, P.E.

Mr. Lanney is a registered Professional Engineer (PE) with more than 17 years of experience in civil and environmental engineering and geology. He has more than ten years of experience in conducting preliminary assessments, site inspections, and remedial investigations of commercial, industrial, and manufacturing sites, as well as DOD facilities.

As CTO Manager he is responsible for the overall technical/project management. He also has the responsibility for procuring and overseeing the staff for the CTO; for the successful, timely and cost effective completion of the field investigations; data collection and evaluation; report preparation; and ensuring that established technical and quality control protocols are adhered to. He will also review and approve all documentation and reports. He will be assisted in executing his responsibilities by the task managers described below.

1.4.2 FS Task Manager - Venu Mukamalla

Mr. Mukamalla will be responsible for the preparation of the feasibility study for Site 09. He is a civil engineer with more than five years experience in hazardous waste consulting industry, including remedial investigations/feasibility studies (RI/FS), remediation, site investigations, and landfill remediation design and cost estimation. He served as a task manager on a number of feasibility studies completed under the CERCLA program. He also served as a task manager on an ARCS II contract in EPA Region II for pre-remedial activities under which he managed 30 Sites. Mr. Mukamalla served as a resident engineer on a chrome remediation project for which he was responsible for implementing a cleanup program for 30 different residential sites. Mr. Mukamalla serves as a design engineer for various remediation projects. In his capacity, he is responsible for preparing preliminary designs for various projects involving tank excavations, capping, barrier well construction and pump and treatment systems.

1.4.3 RA Task Manger - David Ludwig, Ph.D.

Dr. Ludwig will be responsible for overseeing the ecological risk assessment which will be performed by SAIC under subcontract with EA, as well as resolution of the data gaps and problems associated with the terrestrial ecological risk assessment for the NCBC-Davisville.

Dr. Ludwig has 15 years of experience in risk assessment, environmental impact analysis and environmental planning. He leads a national risk assessment group for EA, with technical specialists in environmental chemistry, exposure analysis, systems ecology, fish and wildlife toxicology, and terrestrial, marine, estuarine, and fresh-water biology. His expertise includes decision making and remedial action alternative selection at a number of complex hazardous waste sites nationwide.

He has coordinated and managed NEPA/EIS projects incorporating impact evaluation for sensitive habitats and protected species. His risk assessment work includes the coordination and management of human health and ecological risk-based RI/FS activities at hazardous waste sites, work plan preparation, study implementation, and data analysis. His teams have conducted quantitative risk assessments nationwide in diverse ecosystems. At a number of sites being worked under his guidance, risk assessment and risk management activities have been driven by ecological issues, for which Dr. Ludwig's teams provided innovative, cost-effective, and scientifically sound risk assessments.

1.4.4 Senior Technical Review

The Senior Technical Reviewers are responsible for providing independent review of draft and final project deliverables in accordance with EA's Quality Management Plan for the Base Realignment and Closure Comprehensive Long-Term Environmental Action Navy Contract N62472-92-D-1296. A brief summary of each reviewer's experience is presented below.

1.4.4.1 RI Senior Technical Reviewer - James Shultz, CPG

James Shultz is a professional geologist with over 20 years of experience. Mr. Shultz has participated and managed remedial investigations at major DOD facilities and industrial facilities where solvent releases have occurred, and at petroleum terminals and retail service stations. Mr. Shultz also has extensive experience in conducting geologic studies to support the development of high yield water supply wells.

1.4.4.2 FS Senior Technical Reviewer - Leo Frey, P.E.

Mr. Frey's educational and work experience in geology and geotechnical engineering qualify him to provide senior technical review of projects involving site investigation and characterization, remedial alternative evaluation, site remediation, geotechnical construction, and landfill design. He has additional experience in construction oversight, preparation of state/federal solid or hazardous waste permits involving remedial actions, client support, public meetings, and regulatory interaction.

1.4.4.3 RA Senior Technical Reviewer - Stephen E. Storms, Ph.D.

Dr. Storms is an ecologist with 25 years experience who has specialized in the responses of aquatic communities to environmental stresses including toxic and conventional pollutants. His work in risk assessment at Kelly AFB, Texas, included evaluation of the potential impacts to a creek from contamination at the Air Force Base and the degree to which ongoing remedial operations at the base might decrease the extent or severity of the impacts. His work includes the management of a project which ranked the human health and environmental risks of land-based sewage sludge management alternatives for the City of New York.

1.4.5 Program Manager - Chuck Houlik, Ph.D., CPG

Dr. Houlik has more than 20 years of experience in the performance and management of multidisciplinary investigations addressing environmental issues and/or in support of engineering design. He is a Certified Professional Geologist with extensive experience in waste management, contaminant assessment, impact assessment, environmental remediation, and facilities siting. In addition to providing final technical review of work products for this CTO, his responsibilities will include project oversight, assisting the CTO Manager in assignments, and ensuring that the field team is responsive to the Quality Assurance and Program Health and Safety Officer.

1.4.6 QA Manager - Robert Cypher

EA's Corporate QA Manager, Mr. Robert Cypher, will be the responsible Quality Assurance Officer for this project. The QA Manager reports independently to the Corporate President and, hence, has full authority to act independently from the technical line management structure. He will serve as EA's primary contact with the Northern Division's QA staff, if so requested by the EIC. He will monitor compliance of the project with the QAPP plan, and perform any necessary performance or system audits.

1.5 WORKPLAN ORGANIZATION

This workplan is organized as follows:

Chapter 1 presents the objectives of the remedial investigations and ecological risk assessment, the purpose and scope of the work plan, and key personnel.

Chapter 2 presents the site history, geology, and hydrogeology.

Chapter 3 presents the field sampling plan, and includes a discussion of objectives, data gaps, data needs, and data quality objectives.

Chapter 4 presents the Quality Assurance Project Plan (QAPP) including analytical methods and data reporting.

Chapter 5 presents a brief summary of how the field data will be assessed and evaluated.

Appendix A is the Safety, Health and Emergency Response Plan (SHERP).

Appendix B includes the investigative methodologies to be used, including equipment, and sample handling for subsurface soil and samples; decontamination procedures; and waste handling procedures.

Appendix C is the workplan for the marine ERA.

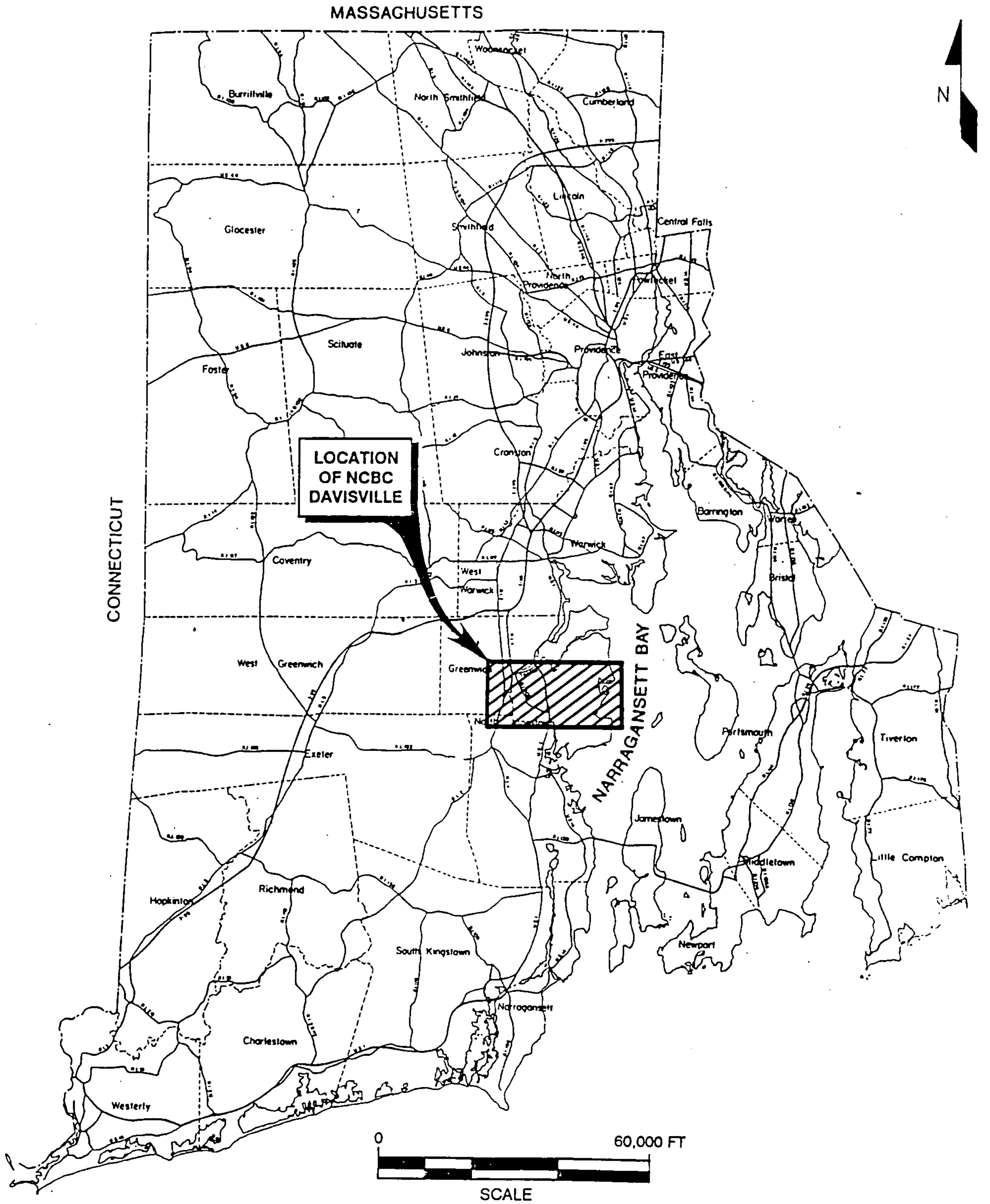
Appendix D presents background information regarding potentially pooled DNAPL at Site 09.

Appendix E presents the details regarding resolution of data gaps and problems associated with the terrestrial/freshwater wetlands ERA for the NCBC.

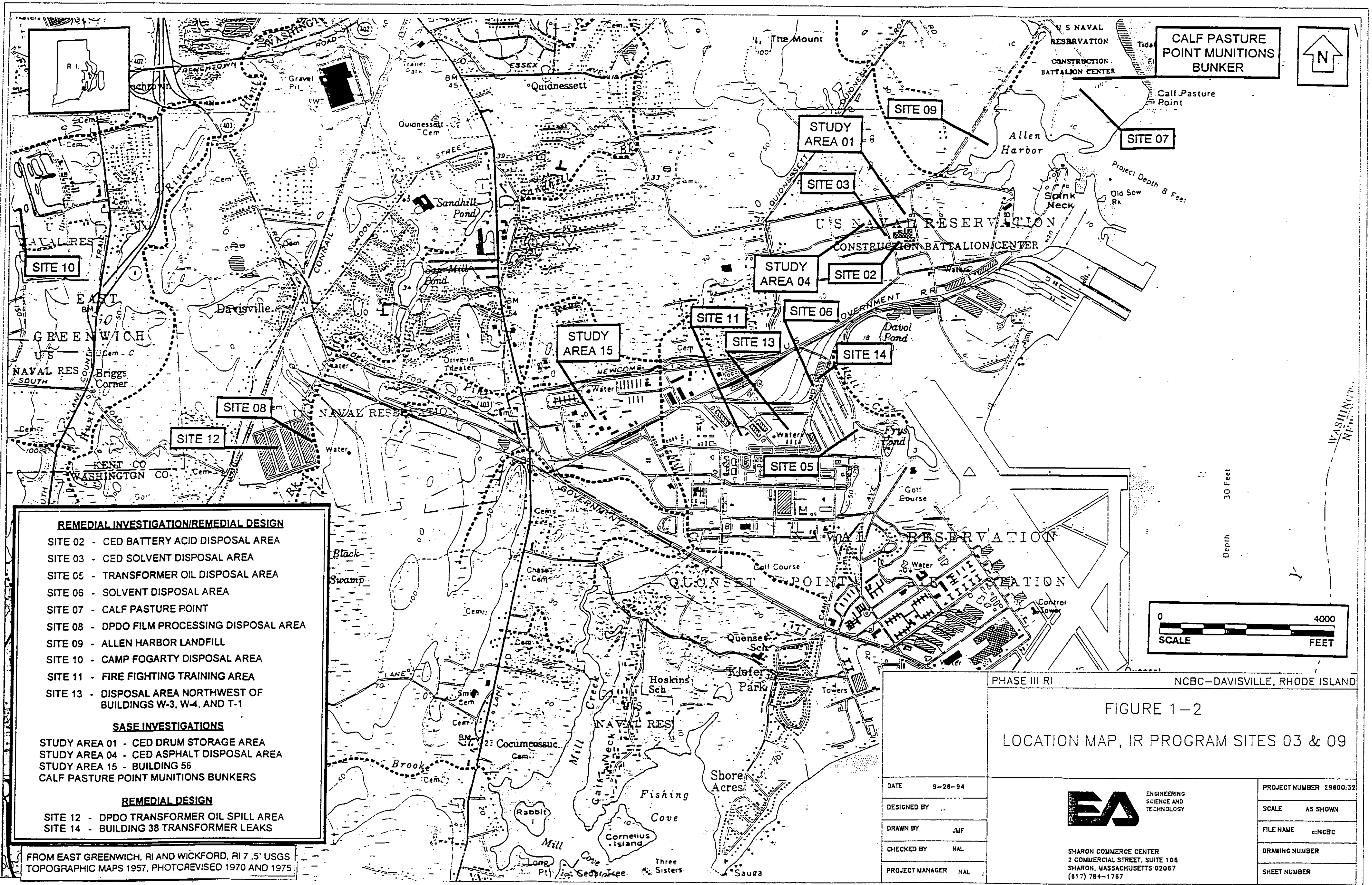
1.6 PROJECT SCHEDULE

A proposed project schedule showing proposed activities, activity duration, and activity start and finish dates related to Sites 03 and 09 is presented in Figure 1-6.

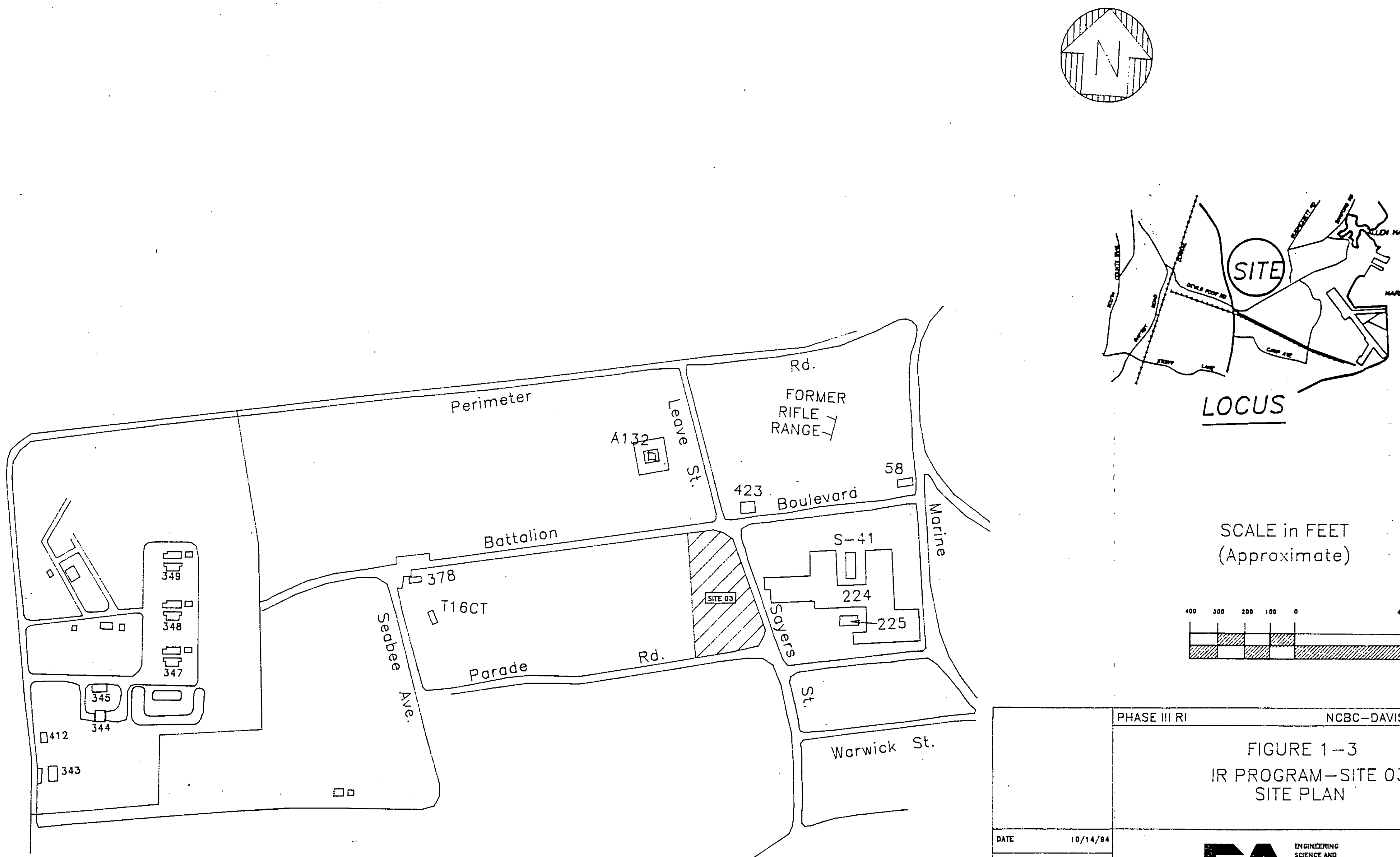
The schedule for the facility-wide ecological risk assessment activities has not yet been finalized; additional sampling is required to respond to EPA's comments, but these samples cannot be collected until early spring 1995 in order for the samples to reflect growing conditions. Analytical results from the field sampling would be available approximately 30 days after sampling, and the revised ecological risk assessment will be completed approximately 30 days after the availability of the analytical results.



ENGINEERING SCIENCE and TECHNOLOGY	DRAWN BY: JMF	PROJECT NO: 29600.32/3100	PHASE III RI — NCBC-DAVISVILLE
	REVIEWED BY: NAL	DATE: 10/17/94	FIGURE 1-1 IR PROGRAM SITE LOCATION PLAN
	APPROVED BY: NAL	SCALE: AS SHOWN	



Reference: TRC ENVIRONMENTAL CORPORATION. DRAFT FINAL PHASE II RI REPORT : 1994



PHASE III RI | NCBC-DAVISVILLE, RHODE ISLAND

FIGURE 1-3
IR PROGRAM-SITE 03
SITE PLAN

DATE	10/14/94
DESIGNED BY	GML
DRAWN BY	JMF
CHECKED BY	NAL
PROJECT MANAGER	NAL

EA ENGINEERING SCIENCE AND TECHNOLOGY

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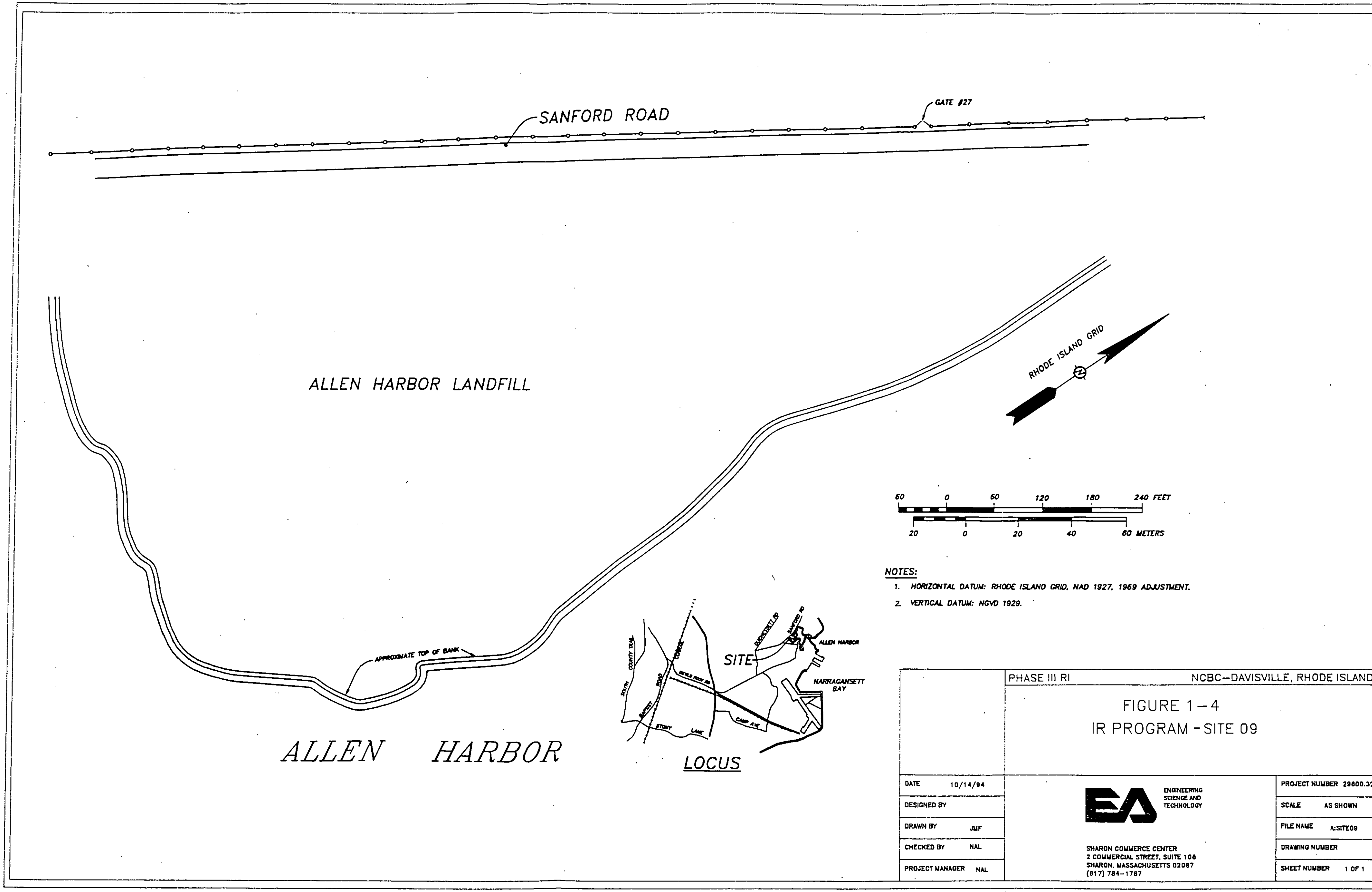
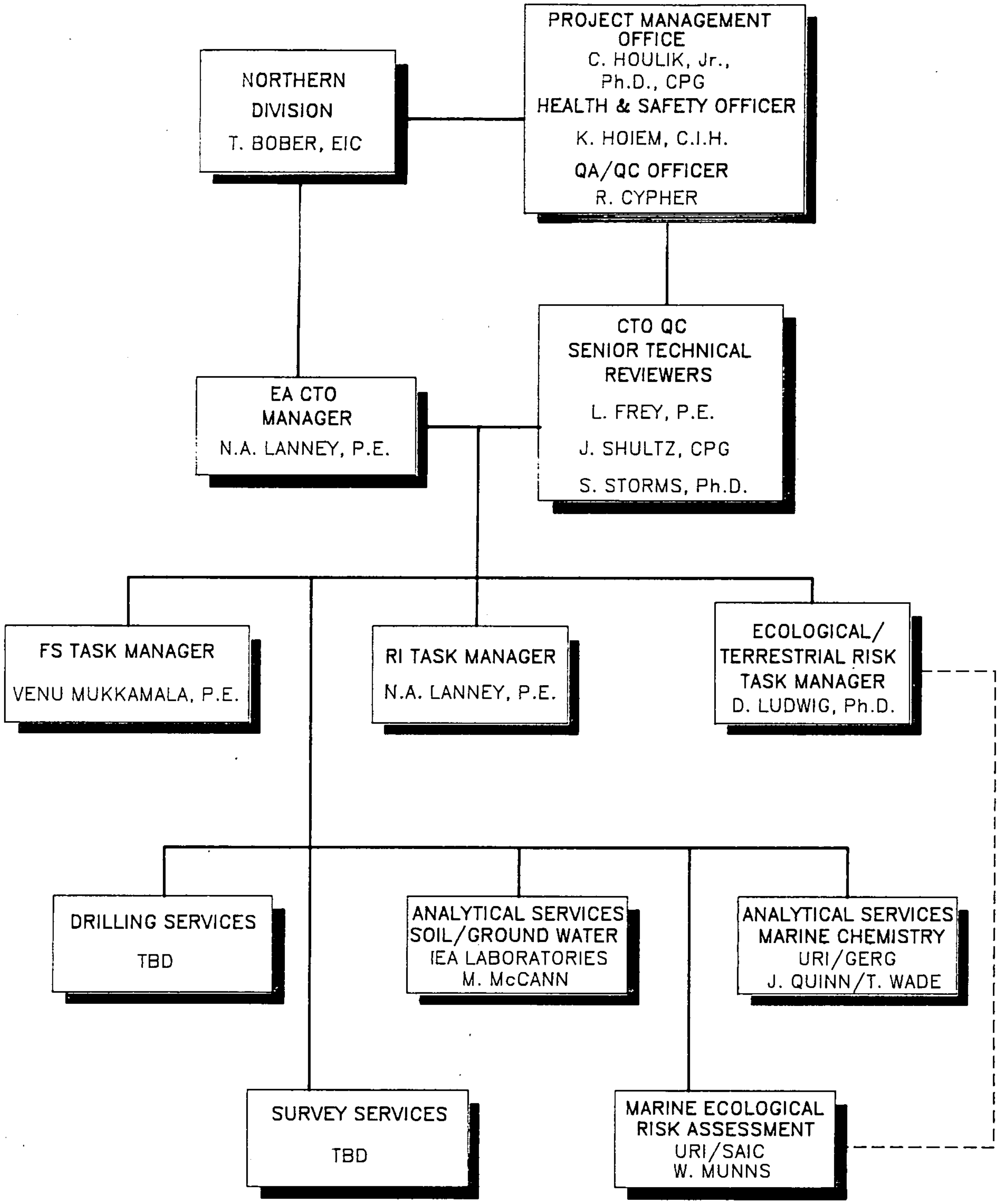
PROJECT NUMBER	29600.32
SCALE	1"=400'
FILE NAME	A:SITE03
DRAWING NUMBER	
SHEET NUMBER	1 OF 1

SOURCE: NCBC-DAVISVILLE STATION MAP. SEPTEMBER 1992



Reference: TRC Environmental Corporation. Draft final RI—Allens Harbor Landfill: 1994



EA ENGINEERING SCIENCE and TECHNOLOGY

DRAWN BY:	PROJECT NO:	PHASE III RI	NCBC–DAVISVILLE
GML	29600.32/3100		
REVIEWED BY:	DATE:		
NAL	10/17/94		
APPROVED BY:	SCALE:		
NAL	AS SHOWN		

FIGURE 1–5
IR PROGRAM
CTO ORGANIZATION CHART

ID	Name	Duration	Scheduled Start	Scheduled Finish
1	Notice to Proceed	0d	9/22/94	9/22/94
2	Secure Subs	39d	9/22/94	11/15/94
3	Draft Workplan	20d	10/3/94	10/28/94
4	Draft Workplan Review	10d	10/29/94	11/11/94
5	Final Workplan	10d	11/14/94	11/25/94
6	Pre-Mobilization Meeting	0d	11/28/94	11/28/94
7	Soil Sampling - Site 09	12d	11/29/94	12/14/94
8	Soil Sampling - Site 03	7d	12/15/94	12/23/94
9	Ground Water Monitoring	4d	12/14/94	12/19/94
10	Allen Harbor Sampling	7d	11/29/94	12/7/94
11	Ground water Sampling	4d	1/3/95	1/6/95
12	Lab Analysis	44d	12/6/94	2/4/95
13	Data Validation	23d	1/16/95	2/15/95
14	Draft Remedial Investigation	55d	1/15/95	3/31/95
15	Draft Ecological Risk Assessment	55d	1/15/95	3/31/95

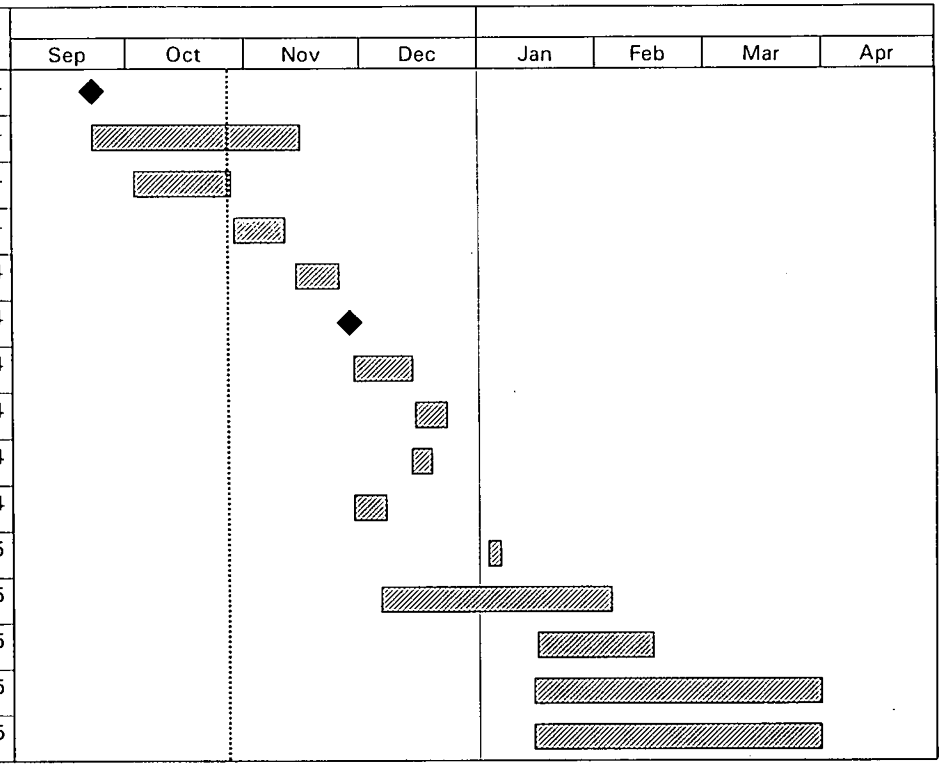


Figure 1-6, Proposed Schedule, IR Program Sites 3 and 9

2.0 BACKGROUND INFORMATION

2.1 SITE HISTORY/DESCRIPTION

2.1.1 NCBC Davisville History/Description

NCBC Davisville is located in the northeast section of the Town of North Kingstown, Rhode Island, approximately 18 miles south of the state capital, Providence. NCBC Davisville is composed of three areas: the Main Center, the West Davisville storage area, and Camp Fogarty, a training facility located approximately 4 miles west of the Main Center (Figure 1-2). A significant portion of NCBC Davisville is adjacent to Narragansett Bay. Adjoining NCBC Davisville Main Center's southern boundary is the decommissioned Naval Air Station (NAS) Quonset Point, which was transferred by the Navy to the RIPA in April 1973 (TRC, 1994). Land use surrounding NCBC Davisville is predominantly residential to the north and south (Environmental Baseline Survey, 1993). West of the Main Center along Route 1, development consists of shopping malls, retail stores, restaurants, and gas stations.

The Davisville/Quonset Point area was originally settled by Europeans in the late 17th century. Quonset Point was the location of the first annual encampment of the Brigade Rhode Island Militia in 1893. During World War I, it was a campground for the mobilization and training of troops and later, the home of the Rhode Island National Guard. In the 1920s and 1930s, it was used as a summer resort for local residents.

In 1939, Quonset Point was acquired by the Navy and construction began in 1940. During construction, millions of cubic yards of sediment were dredged to create the ship basin and channel. The dredged material was used to create a 1.5 mile section in Quonset's northeast corner. Wartime activities at Naval Air Station (NAS) Quonset Point included training aircraft carrier pilots and crews, overhauling aircraft, supplying military equipment and planes, and providing coastal defense.

By 1942, the operations at NAS Quonset Point had outgrown the station. Adjacent land at Davisville was designated as the Advanced Base Depot. Later that year, the Naval Construction Training Center (NCTC), known as Camp Endicott, was established at Davisville to train newly established construction battalions. By November 1942, the camp was at capacity, housing 15,000 enlisted men and 350 officers. Over 100,000 service members were trained at Camp Endicott by the end of World War II.

"The NCBC-Davisville area was inactive between World War II and the Korean Conflict. In 1951, it became the Headquarters Construction Battalion Center. The Construction Battalion Center loaded ships and trained men for both the Korean and Vietnam conflicts. In 1974, the NAS and Naval Air Rework Facility at Quonset Point were decommissioned and operations at Davisville were greatly reduced. In 1989, the closure of Davisville was announced, and all operations at Davisville were phased down to the present staffing levels for Public Works, Maintenance, Security, and Navy Personnel. NCBC Davisville was closed effective April 1, 1994, at which time the staff at NCBC was reduced to a caretaking work force of eight to maintain base security and oversight of maintenance and environmental projects." (TRC, 1994)

2.1.2 IR Program Site 03 - Solvent Disposal Area

IR Program Site 03 is located immediately west of Site 02, in the northern portion of NCBC Davisville (Figure 1-2). The Site consists of a flat and previously paved area, bounded by Sayers Street to the east, Parade Road to the south and Battalion Boulevard to the north (Figure 1-3). The surface of the site is characterized by deteriorated asphalt interspersed with grass.

From 1955 to the late 1970s, approximately 3,000 gallons of paint thinners and unidentified solvents were reportedly disposed on the ground west of Sayers Street and Building 224. While the precise limits of the disposal area are not known, disposal is thought to have occurred in an area adjacent and west of Sayers Street. A portion of the Site was also used for heavy equipment storage. The area further west was reportedly used to store and maintain vehicles. (TRC 1994)

Previous site investigations include: an Initial Assessment Study (IAS) by Fred C. Hart Associates, completed in 1984; a Confirmation Study-Verification step, completed by TRC in 1987; Confirmation Study-Characterization Step, completed by TRC in 1988; and a Phase I Remedial Investigation (RI) completed by TRC in 1991. A Phase II RI, completed by TRC in 1992, was performed to further delineate the horizontal and vertical extent of contamination associated with the solvent disposal area. To further delineate the VOC detected in monitoring well 03-MW-3D (Figure 2-1) during the Phase II RI, TRC conducted a Supplemental Phase II Field Investigation in March 1994.

In general, surface and subsurface soil and shallow ground water reportedly appeared to be minimally impacted by the reported solvent disposal activities. A total of 27 surficial soil samples were collected within Site 03's limits during the Phase I and II RI's. Acetone, toluene and chloroform were detected. TRC (1994) concluded that based on the low concentrations and infrequency of detection, that the reported concentrations may be due to laboratory contamination. Chloroform was detected at 2 ppb in one of two subsurface samples collected during the Phase I RI. Acetone at 20 ppb was reported in only 1 of 12 subsurface soils samples collected and analyzed during the Phase II RI (TRC, 1994). No VOC were detected in ground-water samples collected from wells screened at the water table.

VOC were reported in ground-water samples collected from wells screened at the bottom of the unconsolidated material. Maximum reported concentrations of detected compounds are: 1,2-dichloroethene at 1000 ppb, trichloroethene at 4,000 ppb, 1,1,2-trichloroethane at 82 ppb, and 1,1,2,2-tetrachloroethane at 2,700 ppb (Figure 2-1).

2.1.3 IR Program Site 09 - Allen Harbor Landfill

2.1.3.1 Remedial Investigation

Site 09 covers an area of approximately 13.5 acres along the western side of Allen Harbor. The landfill is bounded to the east and south by Allen Harbor and to the west by Sanford Road (Figures 1-2 and 1-4). A marsh is located to the west of the landfill, on the opposite side of Sanford Road, at the edge of the Navy property. Access to the landfill is controlled by a fence with locked gate at the Sanford Road entrance. The landfill is currently overgrown by shrubs, small trees, and grasses. Substantial amounts of building debris and rusted metallic objects are visible at various locations across the site. Cover materials at the landfill consist of poorly sorted sand and gravel with silt and clay. The cover is non-uniform over the landfill, varying in depth from one to three feet in thickness. (TRC, 1994)

From 1946 to 1972, the Allen Harbor Landfill was used for the disposal of waste generated at NCBC Davisville and NAS Quonset Point. A large variety of waste, including large quantities of preservatives, paint thinners, degreasers, PCB, asbestos, ash, sewerage sludge, 55-gallon drums, used mineral grit, and contaminated fuel oil may have been placed in Allen Harbor Landfill.

Previous site investigations include: an Initial Assessment Study (IAS) by Fred C. Hart Associates completed in 1984; a Confirmation Study-Verification Step completed by TRC in 1987; a Phase I Remedial Investigation completed by TRC in 1991; and a Phase II and Supplemental Phase II Remedial Investigation completed by TRC in 1994.

The objective of the Phase II Remedial Investigation was to further delineate the vertical and horizontal extent of the contamination through a series of test and sampling rounds including:

- Seismic refraction survey.
- Electromagnetic conductivity survey.
- Magnetometry survey.
- Soil and ground-water sampling.
- Installation of wells and piezometer clusters.
- Conductivity testing.

The result of the Phase II RI indicated the need for a limited supplemental investigation at the site. Three soil samples and ground-water samples were collected to determine the salinity across the site and to determine the potential for contaminants to leach from the subsurface soil.

Surface and subsurface soil sampling and analyses identified numerous volatile organic compounds at Site 09. These include the following:

Compound	Maximum Reported Concentration (ppb)
Benzene	3
Ethlybenzene	220
Toluene	82
Xylene	4500
1,1,2,2-Tetrachloroethane	640
Trichloroethene	670
1,1,2-Dichloroethene	3100
1,1,1-Trichloroethane	350
Vinyl Chloride	350
Chlorobenzene	190
Acetone	180
2-Butanone	11
Methylene chloride	88

VOC were also detected in ground-water samples collected from wells screen at the water table including :

Compound	Maximum Reported Concentration (ppb)
1,2-Dichloroethene	510
Vinyl Chloride	25
1,2-Dichloropropane	940
Trichloroethene	74
Tetrachloroethene	670
Benzene	11
Toluene	28
Ethylbenzene	87
Xylene	190
Chlorobenzene	620

Highest total VOC-concentration (2000 ppb) was reported in MW-6S (Figure 2-2).

In the silt unit, significant total VOC-concentration (44,250 ppb) was detected only in the ground-water sample collected from MW-7D. Total VOC concentrations were significantly less in the ground-water samples collected from MW-3D (122 ppb), MW-8D (10 ppb), MW-9D (398 ppb) and MW-13D (2 ppb). No VOC were detected in MW-6D, MW-10D, and MW-12D. (Figure 2-3).

2.1.3.2 Ecological Risk Assessment

A marine ecological risk assessment was undertaken at the Naval Construction Battalion Center, Davisville, Rhode Island to determine the effects of hazardous waste disposal on Allen Harbor and Narragansett Bay. A phased approach was developed involving site characterization (Phase I), assessment of contaminant exposure and biological effects (Phase

II) and quantification of ecological risks (Phase III). Phase I study results showed no major environmental problems unique to Allen Harbor, but did raise questions regarding some aspects of sediment and water quality.

Phase III investigations focused on relative importance and seasonal dynamics of specific contaminant sources including the landfill, surface runoff and marina activities. The study found that runoff and landfill sources were important sources of pollution input into the harbor, whereas marina sources were not. Polluntant source strength was greater for landfill than runoff exposure routes based on tissue residues in indigenous bivalves, with metals and pesticides being highest in spring and summer, respectively. Toxicity testing showed negative impacts due to both surface runoff and in sediments adjacent to the landfill and were not seasonally dependent.

Phase II investigations involved the development of exposure-response models and their application to estimation of ecological risk. Results indicated that the likelihood of biological impairment for species indigenous to Allen Harbor was about 1-in-5 for sea urchin (*Arbacia*) fertilization, and about 1-in-2 for sea urchin development, macro-algal reproduction (*Champia*) and larval clam development (*Mulinia*). Risks beyond immediate proximity to the landfill were not calculated but interpreted to be insignificant given a lack of direct toxicological effect observed in amphipod (*Ampelisca*) and bivalve (*Mulinia*) tests with these sediments. However, calculations suggested that significant risks are possible if contaminants contained in the sediment were to increase in bioavailability.

In June 1994, TRC Environmental produced a draft final Ecological Risk Assessment addressing terrestrial and freshwater risks associated with the NCBC study area. U.S. EPA Rigion I, after revieweing the risk assessment, released in late August 1994 as detailed and extensive series of comments, identifying shortcomings in the risk assessment, and specifying areas of the risk assessment where previous EPA comments had not been addressed, or had been addressed incompletely. Appendix E contains a work plan designed to address the data gaps and issues identified by EPA Region I.

2.2 GEOLOGY/HYDROGEOLOGY/SURFACE WATER HYDROLOGY

The following descriptions of the regional geology, hydrogeology, and surface water hydrology are from the TRC (1994) Draft Final Phase II Remedial Investigation Report: Technical Report, Section 1.

2.2.1 Regional Geology/Hydrogeology

NCBC Davisville is located within the Narragansett Basin, a complex structural syncline approximately 12 miles wide and up to 12,000 feet deep. The Narragansett Basin's western limit is approximately 3 miles west of NCBC Davisville, and its eastern edge is close to Fall River, Massachusetts (Figure 2-4).

The bedrock forming the Narragansett basin consists predominantly of non-marine conglomerate, sandstone, and shale. The principal bedrock unit in the vicinity of NCBC Davisville is the Rhode Island Formation, which consists of fine to coarse conglomerate, lithic graywacke, graywacke, sandstone, shale, and a minor amount of meta-anthracite and anthracite. The color of the unit is gray, dark gray, and greenish, with black shale and anthracite beds. The formation is further characterized by cross-bedding and irregular, discontinuous bedding. In the southern portion of the Basin, which underlies NCBC Davisville, the formation is metamorphosed and contains quartz-mica-sillimanite schist.

The topography of the bedrock surface beneath the Davisville area exhibits over 150 ft of relief in a series of north-south trending valleys and ridges. These valleys were developed by river and stream erosion over a period of approximately 300 million years, and deepened by the Wisconsin Age glacial advances. In the vicinity of NCBC-Davisville, the depth to bedrock ranges from ground surface to approximately 90 ft below ground surface.

The unconsolidated sediment overlying the bedrock was eroded and transported by the advancing glaciers, and then, deposited on the bedrock surface. Till, a dense, non-stratified, heterogeneous mixture of sand, silt, clay, and gravel was deposited as a thin layer directly on top of the bedrock when the advancing glaciers scraped, ground, crushed, and then overrode the bedrock. Till is exposed on highlands such as Lippit Hill, the hillside west of the rifle and pistol range at Camp Fogarty, and along the hillside ridge between West Davisville and NCBC Davisville. Associated with Till are end moraines, which are ridges of sediment deposited at the margin of a glacier when it was stationary. Just northeast of Building 224 (the location of which is shown in Figure 1-3), an end moraine deposit controlled the pro-glacial melt water drainage system.

As streams of melt water flowed from the retreating glaciers, sediment from the melting ice was entrained, transported downstream, and deposited as well-sorted sand or gravel (glacial fluvial deposits). Fine-grained silt and clay was transported by the streams into glacial lakes, where they were deposited onto the lake bottom (glacial lacustrine deposits). Most of the surficial materials in the Davisville area are glacial fluvial or glacial lacustrine deposits. Melt-water streams which flowed along the west side of the end moraine near Building 224, deposited a sequence of sand and silt over most of NCBC Davisville. The thickness of the glacial deposits is quite variable. It is generally thin, often less than 10 ft in thickness at the higher elevations (nonexistent where bedrock is exposed) and over 150 ft in thickness in some portions of the bedrock valleys.

The bedrock units underlying the Davisville area have primary porosities (pore openings between the grains of mineral crystals forming the rock) of less than 1 percent and very low secondary porosities (joints, fractures, and openings along bedding planes). The only openings capable of yielding significant volumes of ground-water are related to the secondary porosity. In general, well yields from the bedrock formations are generally low, about 22 gal per minute (gpm) from an average depth of approximately 225 ft. Flow from secondary porosity openings is greatest in the top 250-300 ft of bedrock. Below this depth, the openings become smaller due to greater overburden pressures.

The glacial deposits in the Davisville area generally consist of the following:

- Stratified sand or gravel interbedded with very fine sand and silt;
- Till, a heterogeneous mixture of silt, sand, clay, and gravel; and
- Stratified sand or gravel interbedded with varying amounts of till.

Each of the above materials will yield ground water, but only the stratified sand and gravel are permeable enough to yield large quantities of water. These very permeable materials form the Hunt Ground-Water Reservoir formerly, prior to 1991, known as the Potowomut-Wickford Aquifer, which is the principal source of potable water in the area. The specific capacities (gal/minute/ft. of drawdown, [gpm/ft]) of several large wells drilled into the stratified deposits range between 5 and 300 gpm/ft of drawdown. Some wells yield as much as 2,700 gpm. A hydrologic review of the aquifer recharge and discharge shows the long-term sustained safe yield of the entire Hunt Ground-water Reservoir is approximately 8 million gallons/day (mgd).

Shallow ground water in the Davisville area is present under unconfined conditions and generally 4-6 ft below the ground surface. Therefore, movement of the ground water is generally in direct response to gravity. The water table is likely a subdued reflection of the surface topography; thus, ground water generally flows from higher topographic areas (zones of recharge) to lower topographic areas (zones of discharge) such as local lakes, streams, swamps, or Narragansett Bay. For the Davisville area, regional ground water flow is west to east. However, for small localized areas, the direction of the shallow ground water flow will be to the nearest downhill discharge area, and thus, can vary from site to site.

Slug tests performed at 49 monitoring wells during the Phase II Remedial Investigation conducted by TRC yielded estimated median shallow-well hydraulic conductivity values (K-values) in the range of 2.2 to 63 ft/day, and median deep-well K-values in the range of 1.3 to 21 ft/day. Average horizontal hydraulic gradients are generally below 2% across TRC's Phase II sites. Using an effective porosity of 20% for silty sand, calculated average linear velocities for the shallow ground water ranged from 0.01 to 1.53 ft/day and for the deep ground water ranged from 0.003 to 0.35 ft/day.

2.2.2 Site Geology and Hydrogeology - Site 03

In general, based upon the logs of borings, overburden deposits at Site 03 consist of fine to medium sand with variable silt and coarse sand content, with silt and gravel layers. A gray silt layer overlies bedrock and extends from the central portion of the site, just west of 03-MW-7D, to across Sayers Street and ranges in thickness from 15 to 20 ft. Total overburden thickness ranged from 39.3 feet to 61.5 feet. Bedrock was encountered at elevations ranging from 25.5 feet below mean sea level (msl) to 8.5 ft below msl. Light to medium gray fine-to medium grained meta-sandstone gneiss with scattered thin gray schist zones was retrieved from NX rock core borings throughout the site. The bedrock appears to slope downward to the east in the western portion of the site and to the northeast and southwest in the eastern portion of the site.

Ground-water elevation data (calculated from depth to water measurements in the monitoring wells) indicates that shallow ground water flows to the east-northeast while deep ground water flows generally to the east. Very low negative vertical hydraulic gradients were measured at the well clusters, indicating that vertical gradients will have a limited impact on contaminant migration. Average linear velocities ranged from 0.48 to 0.92 ft/d for the shallow ground-water and ranged from 0.01 to 0.02 ft/d for deep ground water.

Ground water under Site 03 is classified as GB by RIDEM. GB class ground water is not be suitable for public or private drinking water.

2.2.3 Site Geology and Hydrogeology - Site 09

In general, based upon the logs of borings, unconsolidated sediment deposits at Site 09 consist of three distinct units. These units (presented in order from ground surface downward) include refuse/fill, sand and silt, and silt. The refuse/fill was encountered at a majority of the test borings and monitoring well locations at thicknesses ranging from 4 to as much as 29 feet. Up to 6 feet of fill were identified below the water table near wells 09-MW8D and 09-MW9D and as much as 13 feet of fill were identified below the water table at 09-MW6D. The fill material consists of a heterogeneous mixture of soil and municipal and construction debris, ranging from medium dense to very dense, and containing glass, plastic, metal, asphalt, wood, and construction debris. The sand and silt layer underlying the fill material is quite heterogeneous and is comprised of lenses of fine-to-medium to fine-to-coarse sand interbedded with sandy silt and organic silt and peat. This unit ranges in thickness from less than 1 foot to approximately 20 ft. The most prominent unconsolidated unit beneath the landfill consists of a soft to very stiff gray silt layer with a trace of fine sand. This unit directly underlies the sand and silt layer, overlies the bedrock, and varies in thickness between 27 and 54 feet.

Bedrock was encountered by the borings at depths ranging from approximately 25 to 81 feet below ground surface. The bedrock surface appears to be at its highest on-site elevation (-34 ft msl) in the west-central portion of the landfill (09-MW-7D). Massive and competent to brittle meta-sandstone gneiss, with shattered schist and shale zones was retrieved from NX-core borings taken in the shallow bedrock.

Ground-water table elevation data (calculated from depth to water measurements in the monitoring wells) indicate that shallow ground-water-flow patterns at Site 09 are complex due to the presence of fill material and the landfill's proximity on three sides to Allen Harbor or wetlands. It appears that the highest site shallow ground-water elevations are located in a roughly north-south trending zone through the central portion of the site. Along the eastern and southern portion of the landfill, shallow ground-water flows towards Allen Harbor. Along the southwestern and western flanks of the landfill, shallow ground-water flows generally southwest toward the wetlands. Deep ground-water piezometric surface elevations reflect tidal influence.

During a low tide stage, deep ground-water horizontal hydraulic gradients were directed toward Allen Harbor. However, during a high tidal stage, deep ground-water horizontal hydraulic gradient essentially reversed, directed inland away from Allen Harbor. Upward gradients of 0.052 ft/ft, and downward gradients of 0.049 ft/ft were measured at Site 09. The variability in the measured vertical gradients is likely due in part to tidal effects. Average horizontal gradients for shallow ground water ranged from 0.0042 ft/ft to 0.0169 ft/ft to the southeast. Average deep ground-water horizontal gradients ranged from 0.0006 ft/ft to the northwest to 0.0047 ft/ft to the southeast. The average linear velocity of shallow ground-water ranged from 0.24 ft/day to 0.97 ft/day, while deep ground-water linear velocities ranged from 0.004 ft/day to 0.03 ft/day.

Ground-water under Site 09 is classified as GB by RIDEM. GB class ground water is considered not suitable for public or private drinking water use. GB classified ground water is primarily located at highly urbanized areas or is located in the vicinity of disposal sites for solid waste, hazardous waste, or sewage sludge.

2.2.4 Surface Water Hydrology

NCBC Davisville lies within the Hunt River and Coastal drainage basins. Camp Fogarty and West Davisville lie within the eastern portion of the Hunt River drainage basin, and NCBC Davisville's Main Center lies within the Coastal drainage basin. All stream and river flow eventually discharges into Narragansett Bay. During most of the year, a part of the stream flow consists of water discharged from retention storage in natural, as well as man-made impoundments. The remaining flow is from direct runoff of precipitation and from base runoff consisting largely of ground-water discharge. The ground-water contributes close to 50% of the average annual stream flow.

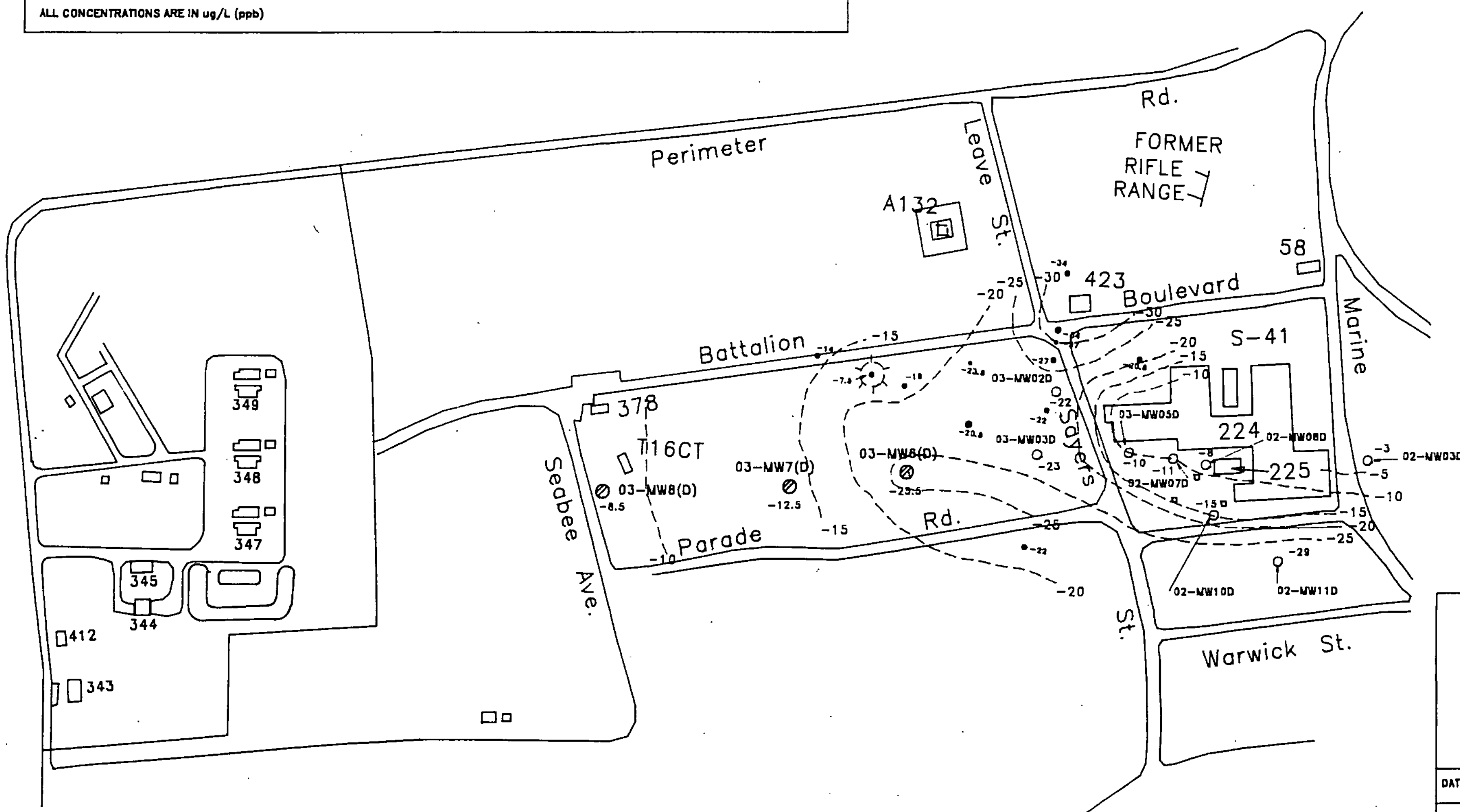
Annual precipitation in the area has ranged from 24.8 inches to 66.2 inches with an average of 42.3 inches. The frequency of measurable precipitation events (0.01 inch or greater) averages once every three days and is evenly distributed throughout the year. The average annual snowfall is almost 40 inches and has varied from 11.3 to 75.6 inches. Roughly 36% of the precipitation recharges the ground-water system; the other 64% runs off into streams or is lost through evapotranspiration.

WELL NO.	1,2 DICHLOROETHENE (TOTAL)	TRICHLOROETHENE	1,1,2-TRICHLOROETHANE	1,1,2,2-TETRACHLOROETHANE
02-MW03D	14	--	--	--
02-MW07D	51	75	15	--
02-MW08D	--	--	--	--
02-MW10D	27	10	10	--
02-MW11D	9J	--	--	--
03-MW02D	--	--	--	--
03-MW03D	120	210	9J	100
03-MW05D	--	--	--	--
03-MW06D	280	1,000	22J	410
03-MW07D	210	680	20J	310
03-MW08D	1,000	4,000	82J	2700

J = ESTIMATED CONCENTRATION

-- = NON DETECT

ALL CONCENTRATIONS ARE IN ug/L (ppb)



N

LEGEND

-34 ESTIMATED DEPTH TO BEDROCK USING SEISMIC REFRACTION, HAGER-RICHTER GEOSCIENCE INC., 1993

-----$^{-10}$ INTERPRETIVE BEDROCK SURFACE CONTOUR WITH ELEVATION IN FEET BELOW MSL

○ EXISTING WELL (PHASE I REMEDIAL INVESTIGATION)

⊘ EXISTING WELL (SUPPLEMENTAL PHASE II REMEDIAL INVESTIGATION

SCALE in FEET (Approximate)

400 300 200 100 0 400

NOTE: BEDROCK SURFACE ELEVATION INTERPRETED FROM BORING LOGS, GEOLOGIC CROSS SECTIONS AND AT SELECTED POINTS ALONG GEOPHYSICAL SEISMIC LINE CROSS SECTIONS

PHASE III RI — NCBC-DAVISVILLE, RHODE ISLAND

FIGURE 2-1
IR PROGRAM - SITE 03
DEEP GROUND WATER VOC
DISTRIBUTION AND BEDROCK CONTOUR MAP

DATE	10/17/94
DESIGNED BY	GML
DRAWN BY	JMF
CHECKED BY	NAL
PROJECT MANAGER	NAL

EA ENGINEERING SCIENCE AND TECHNOLOGY

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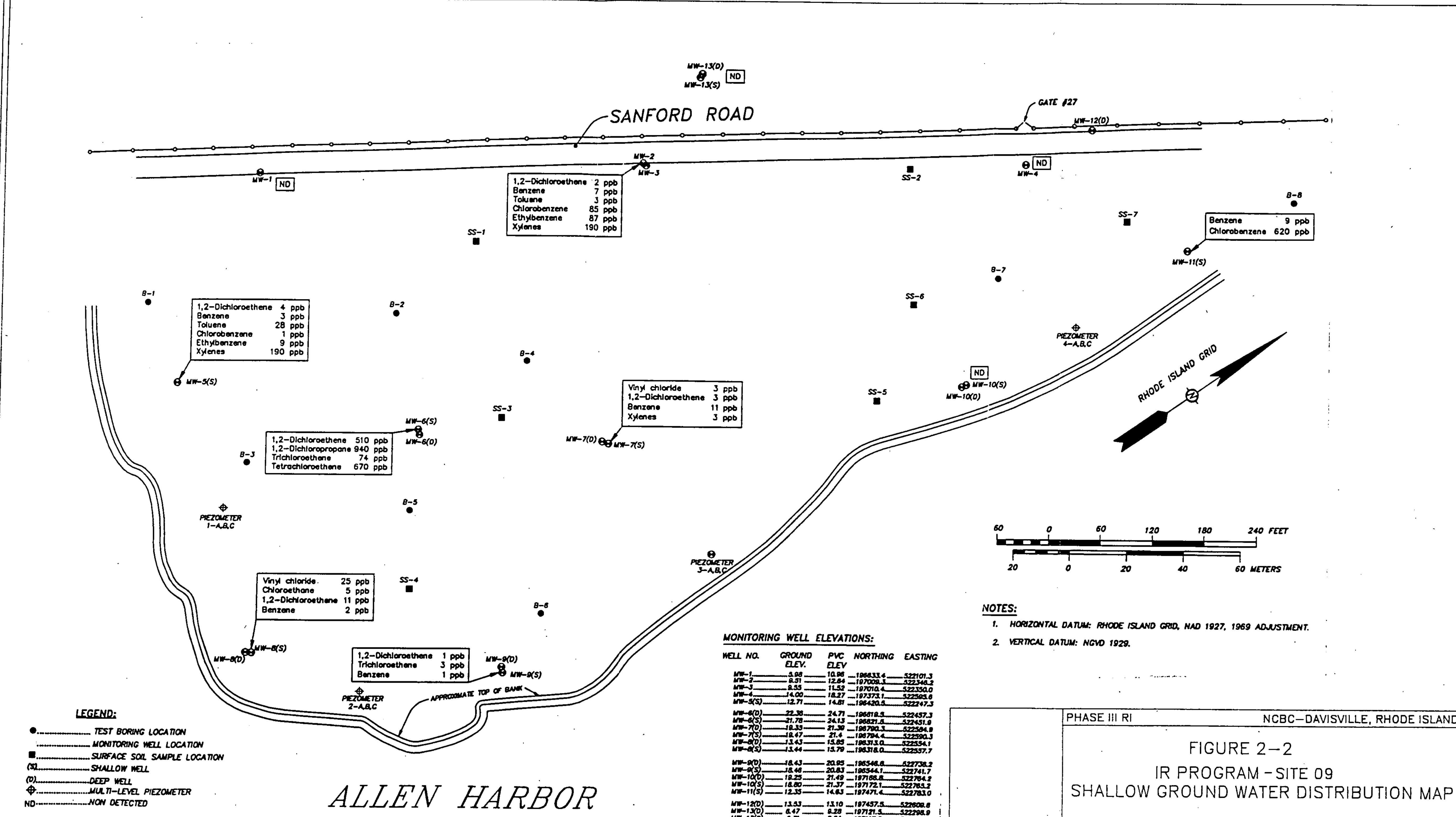
PROJECT NUMBER	29600.32
SCALE	1"=400'
FILE NAME	A:\F102-1
DRAWING NUMBER	
SHEET NUMBER	1 OF 1



LEGEND:

- TEST BORING LOCATION
- MONITORING WELL LOCATION
- SURFACE SOIL SAMPLE LOCATION
- (S) SHALLOW WELL
- (D) DEEP WELL
- MULTI-LEVEL PIEZOMETER
- ND NON DETECTED

NOTES:

1. HORIZONTAL DATUM: RHODE ISLAND GRID, NAD 1927, 1969 ADJUSTMENT.
2. VERTICAL DATUM: NGVD 1929.

MONITORING WELL ELEVATIONS:

WELL NO.	GROUND ELEV.	PVC ELEV	NORTHING	EASTING
MW-1	5.98	10.96	196633.4	522101.3
MW-2	9.51	12.64	197009.3	522346.2
MW-3	9.55	11.52	197010.4	522350.0
MW-4	14.00	18.27	197373.1	522595.6
MW-5(S)	12.71	14.81	196420.5	522247.3
MW-6(D)	22.38	24.71	196619.5	522457.3
MW-6(S)	21.78	24.13	196621.6	522451.9
MW-7(D)	19.35	21.39	196790.3	522584.9
MW-7(S)	19.47	21.4	196794.4	522590.3
MW-8(D)	13.43	15.85	196313.0	522554.1
MW-8(S)	13.44	15.79	196318.0	522557.7
MW-9(D)	18.43	20.95	196546.6	522738.2
MW-9(S)	18.46	20.83	196544.1	522741.7
MW-10(D)	19.25	21.49	197168.8	522764.2
MW-10(S)	18.80	21.37	197172.1	522765.2
MW-11(S)	12.35	14.63	197471.4	522783.0
MW-12(D)	13.53	13.10	197457.5	522609.6
MW-13(D)	6.47	9.28	197121.5	522298.9
MW-13(S)	6.31	8.84	197117.6	522300.7

PHASE III RI — NCBC-DAVISVILLE, RHODE ISLAND

FIGURE 2-2
IR PROGRAM - SITE 09
SHALLOW GROUND WATER DISTRIBUTION MAP

DATE	10/14/94
DESIGNED BY	
DRAWN BY	JMF
CHECKED BY	NAL
PROJECT MANAGER	NAL

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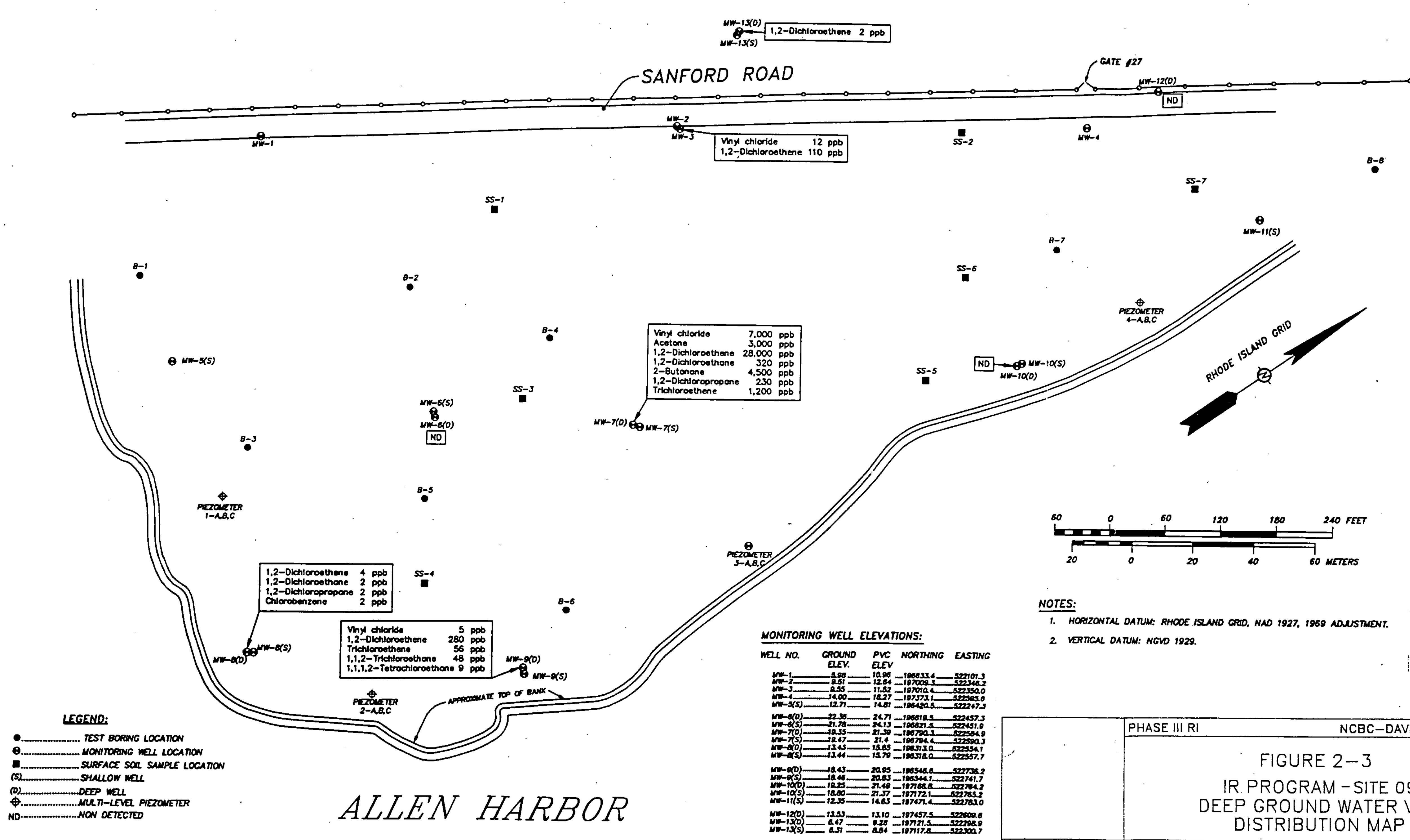
(617) 784-1767

PROJECT NUMBER	29600.32
SCALE	AS SHOWN
FILE NAME	a:SGWV
DRAWING NUMBER	
SHEET NUMBER	

Reference: TRC ENVIRONMENTAL CORPORATION. DRAFT FINAL RI—ALLEN HARBOR LANDFILL: 1994



LEGEND:

- ●........ TEST BORING LOCATION
- ⊖........ MONITORING WELL LOCATION
- ■........ SURFACE SOIL SAMPLE LOCATION
- (S)........ SHALLOW WELL
- (D)........ DEEP WELL
- ⊕........ MULTI-LEVEL PIEZOMETER
- ND........ NON DETECTED

NOTES:

1. HORIZONTAL DATUM: RHODE ISLAND GRID, NAD 1927, 1969 ADJUSTMENT.
2. VERTICAL DATUM: NGVD 1929.

MONITORING WELL ELEVATIONS:

WELL NO.	GROUND ELEV.	PVC ELEV	NORTHING	EASTING
MW-1	8.98	10.96	196833.4	522101.3
MW-2	9.51	12.64	197009.3	522346.2
MW-3	9.55	11.52	197010.4	522350.0
MW-4	14.00	18.27	197373.1	522505.6
MW-5(S)	12.71	14.81	196420.5	522247.3
MW-6(D)	22.36	24.71	196819.5	522457.3
MW-6(S)	21.78	24.13	196821.5	522451.9
MW-7(D)	19.35	21.39	196790.3	522584.9
MW-7(S)	19.47	21.4	196794.4	522590.3
MW-8(D)	13.43	15.85	196313.0	522554.1
MW-8(S)	13.44	15.79	196318.0	522557.7
MW-9(D)	18.43	20.95	196546.8	522736.2
MW-9(S)	18.46	20.83	196544.1	522741.7
MW-10(D)	19.25	21.49	197168.8	522764.2
MW-10(S)	18.80	21.37	197172.1	522765.2
MW-11(S)	12.35	14.63	197471.4	522783.0
MW-12(D)	13.53	13.10	197457.5	522609.8
MW-13(D)	6.47	9.28	197121.5	522298.9
MW-13(S)	6.31	8.84	197117.8	522300.7

PHASE III RI — NCBC-DAVISVILLE, RHODE ISLAND

FIGURE 2-3

IR PROGRAM - SITE 09
DEEP GROUND WATER VOC
DISTRIBUTION MAP

DATE	10/14/94
DESIGNED BY	
DRAWN BY	JMF
CHECKED BY	NAL
PROJECT MANAGER	NAL

EA ENGINEERING SCIENCE AND TECHNOLOGY
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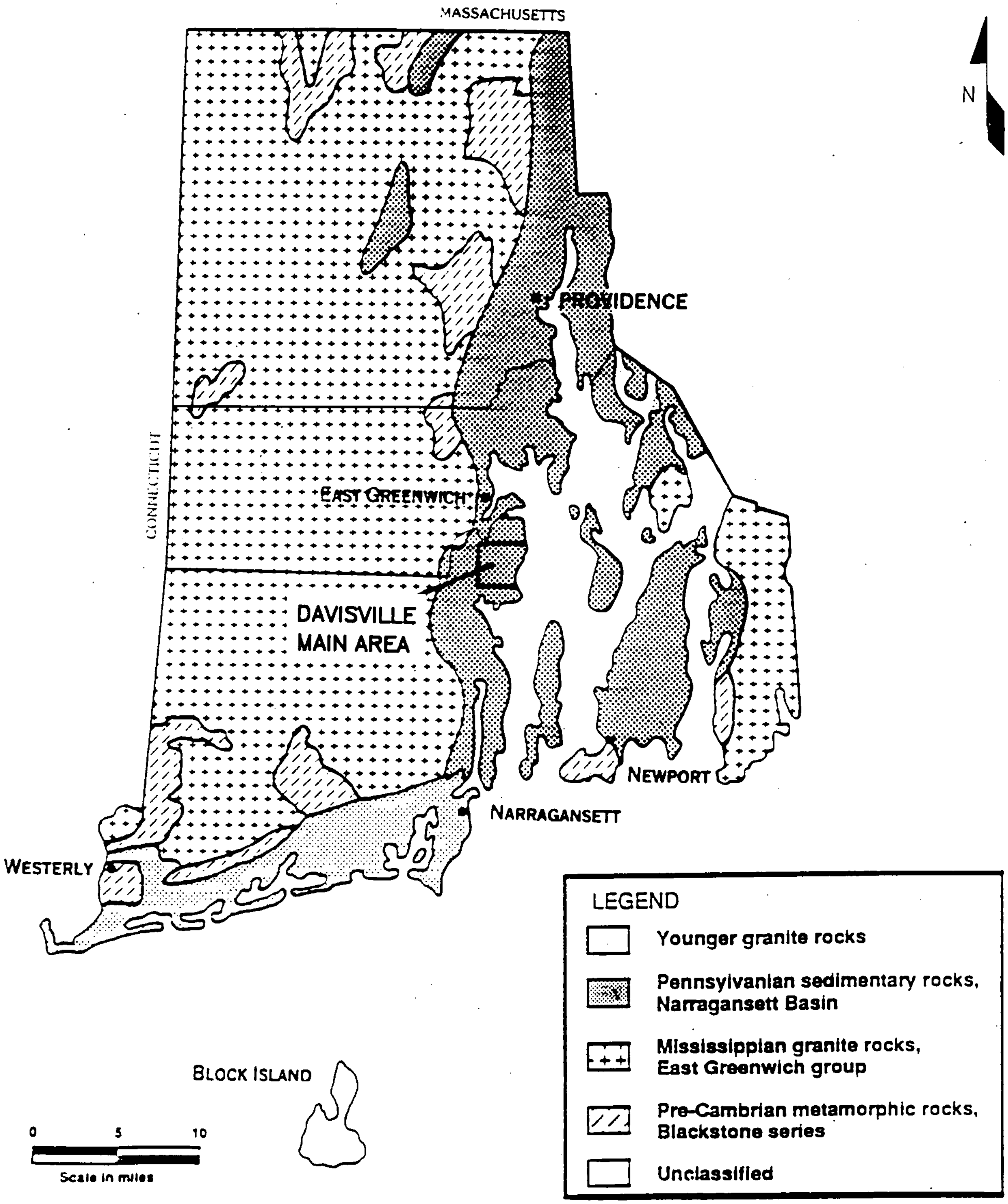
PROJECT NUMBER	29600.32
SCALE	AS SHOWN
FILE NAME	A:FIG2-3
DRAWING NUMBER	
SHEET NUMBER	

Reference: TRC ENVIRONMNENTAL CORPORATION. DRAFT FINAL RI-ALLEN HARBOR LANDFILL: 1994



REFERENCE: SOIL SURVEY OF RHODE ISLAND, UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE IN COOPERATION WITH RHODE ISLAND AGRICULTURE EXPERIMENT STATION.

EA ENGINEERING SCIENCE and TECHNOLOGY	DRAWN BY: GML	PROJECT NO: 29600.32/3100	PHASE III RI — NCBC–DAVISVILLE
	REVIEWED BY: NAL	DATE: 10/17/94	FIGURE 2–4 IR PROGRAM GENERAL GEOLOGICAL MAP OF RHODE ISLAND
	APPROVED BY: NAL	SCALE: AS SHOWN	

3.0 FIELD SAMPLING PLAN

3.1 INTRODUCTION

The objective of this workplan is to provide procedures to implement the Phase III RI scope of work described in Section 1.3.

The field sampling plan (FSP) in conjunction with the Quality Assurance Project Plan (QAPP), presented in Chapter 4, has been prepared to meet this objective.

3.2 FIELD SAMPLING PLAN - SITE 03

Previous investigations at this site reported that chlorinated VOC were detected in ground-water samples collected from the unconsolidated aquifer just above the top of bedrock, and upgradient of the suspected location of Site 03 (Figure 1-3). Chlorinated VOC were reportedly not detected in ground-water samples collected at the water table zone. These previous investigations were unable to identify the source area(s), adequately characterize the extent of VOC in ground water, or provide sufficient information to evaluate fate-transport mechanisms. The following information will be obtained for the Phase III RI:

1. Horizontal extent of VOC in the ground water just above the top of bedrock, upgradient and cross gradient from 03-MW-07D and 03-MW-08D.
2. Generalized bedrock surface topography in the area.
3. Location of source(s).

The sample plan for Site 03 is as follows. This field work will be performed in accordance with the proceedures presented in Appendix B.

Drill two borings cross gradient (03-MW-9D and 03-MW-11D) and two borings upgradient (03-MW-10D and 03-MW-12D) of existing wells 03-MW-07D and 03-MW-08D as shown on Figure 3-1. Advanced the borings to bedrock. This data will be used to construct a generalized bedrock surface contour map of the site.

Collect split spoon soil samples at five foot intervals at each boring and screen the headspace of each soil sample in the field for VOC using a portable gas chromatograph. Select the two soil samples from each boring having the highest total VOC headspace screening results and submit them for laboratory analysis for TCL VOC. If VOC are not detected in any of the soil headspace samples, then submit the soil sample collected from approximately 2 to 4 ft above the apparent water table and the soil sample from approximately 10 to 12 ft below the apparent water table for laboratory analysis for TCL VOC. The analytical results will be used to aid in locating potential VOC source areas.

Install four monitoring wells. With the well screens set in the unconsolidated sediment just above the bedrock surface. Collect a groundwater sample from each well and analyze the sample for TCL VOC. The water chemistry data will be used to evaluate the nature of the chlorinated VOC in deep ground water at each of the four well locations.

Determine the water table elevation for the wells at Sites 02 and 03. This data will be used to construct interpretive piezometric and water table contour maps of deep and shallow ground water, respectively.

To ensure that the data collected during the field investigation will meet the data quality objectives of the project, USEPA Data Quality Objective (DQO) Levels I (field screening using portable equipment), Level II (field screening using a mobile GC) and Level IV (TCL with data validation) will be used.

3.3 FIELD SAMPLING PLAN - SITE 09

Previous investigations and studies at Allen Harbor landfill have focused on evaluating the landfill, the water table aquifer and the bottom of the silt unit (just above the top of bedrock), the human health and ecological risks associated with the landfill (TRC, 1994), and the ecological risk associated with shallow sediment (within the zone of bioturbation) in Allen Harbor (Munns et al.). That ecological risk assessment did not differentiate between stressors introduced by the landfill and stressors introduced from other sources.

The following data gaps have been identified at Site 09.

Presence, nature and extent of potentially "pooled" DNAPL or high concentrations of dissolved-phase chlorinated VOC at the interface of the sand and silt strata (bottom of the upper aquifer) at 09-MW-07. (See Appendix D for further information).

Whether or not the high concentration of VOC detected once in a ground-water sample from 09-MW-07D is representative of the chemistry of the ground water within the silt unit.

The potential ecological impact of VOC apparently present in the silt unit migrating through the bedrock, and discharging into the sediment beneath Allen Harbor.

The potential impact the bringing sediment from below the zone of bioturbation in Allen Harbor into contact with sediment in the zone of bioturbation and the water column resulting from clamming, dredging, or storm surges.

The potential ecological impact of the landfill on the salt water marsh/wetlands to the north and south of the landfill.

The sampling plan for Site 09 is as follows. This field work will be performed in accordance with the procedures presented in Appendix B.

- Investigate potentially "pooled DNAPL" and the vertical extent of contamination will be accomplished using a phased approach. First, install two shallow monitoring wells (09-MW-14S and 09-MW-15S) within approximately 10 and 30 ft of 09-MW-07D (Figure 3-2). Screen these two wells at the base of the upper aquifer to confirm if there is a concentrated VOC source area in the vicinity of monitoring well 09-MW-07S (which has a screened interval at the top of the upper aquifer, not the base). The installation of additionaly shallow wells may be recommended based upon the findings of the first two shallow wells (Refer to Appendix D).

- Advance the two shallow borings/monitoring wells using hollow stem augers. Perform split spoon sampling of the soil at 5 ft intervals to a depth of approximately 20 ft below ground surface, and then, continuously to about 5 ft into the silt unit. Perform headspace screening of each soil sample as described in Appendix B, Section 3.1.1. Submit the two soil samples in each of the boreholes with the highest headspace screening results for laboratory analysis for TCL VOC. If headspace screening does not detect VOC, then select the two soil samples per boring as follows for analysis for TCL VOC: one sample from approximately 2 to 4 ft into the native geologic sediment beneath the landfill, and one sample from approximately 2 to 4 ft above sand/silt unit interface at the base of the upper aquifer. Construct a monitoring well in each borehole with a 10-ft screen set approximately 1 ft into the silt unit. Perform slug testing of each well to provide data for evaluation of the hydraulic conductivity of the geological material adjacent to the screen.

- Whether or not DNAPL and/or high concentration of dissolved chlorinated solvent is encountered by the initial two wells, install a replacement well for 09-MW-7D into the silt unit, to evaluate: 1) the presence of chlorinated VOC in the silt unit; or 2) whether the VOC detected in 09-MW-07D was possibly introduced during the drilling activities of that well.

- Drill and install monitoring well 09-MW-16 to the base of the silt unit using the methods presented in Appendix B, Sections 1.2 and 2.1. Perform headspace screening on each soil sample and use the results in selecting the two samples with the highest results from the borehole for TCL VOC analysis. If headspace screening does not detect VOC, then select the two soil samples per boring as follows for analysis for TCL VOC: one sample from approximately 2 to 4 ft below the bottom of the steel casing, and one sample from approximately 3 to 5 ft above the base of the silt unit. Perform slug testing of each well to provide data for evaluation of the hydraulic conductivity of the geological material screened.

- Drill two borings (09-MW-17 and 09-MW-18) 20 to 30 ft into bedrock and construct monitoring wells at the locations shown on Figure 3-2. Advance the borings through soil using hollow stem augers (Appendix B, Section 1.2). Collect split spoon soil samples at 5-ft intervals to the top of bedrock. Perform headspace screening of each soil sample and use the screening results to assist in selecting the two soil samples with the highest results from each boring for TCL VOC analysis. If headspace screening does not detect VOC, then select two soil samples per boring as follows for analysis for TCL VOC: one sample from approximately 2 ft above the sand/silt interface (bottom of the upper aquifer), and one sample approximately 5 ft above the bottom of the silt unit. Perform packer testing to provide data for evaluation of the hydraulic conductivity of the upper portion of the bedrock. Perform slug testing of the well to provide data for evaluation of the hydraulic conductivity of the geological material adjacent to the screen.

- Collect ground-water samples from 09-MW-6D, 09-MW-8D, 09-MW-9D, 09-MW-10D, 09-MW-14 through 09-MW-18 and analyze the samples for TCL VOC. These wells were selected because four would provide water quality data representative of subject VOC study area, while the remaining five would provide water quality data representative of ground water in the silt and bedrock that may discharge into Allen Harbor.

- Perform continuous ground-water monitoring in eight monitoring wells (Figure 3-2) screened in either the upper aquifier silt unit or bedrock aquifier for a three-day period. Pressure transducers will be installed in eight wells. The transducers will be connected to a Hermit recorder (or similar) in order to electronically record the water level fluctuations. Install a tidal gauge to monitor tidal changes in Allen Harbor for the same time period. Manually measure the water level in the remaining monitoring wells at least three times per day during the three-day monitoring period. Perform salinity measurements in all monitoring wells when the water levels are manually measured.

- Collect sediment core samples from ten locations in the wetlands and Allen Harbor at the locations shown on Figure 3-3. Select horizons in the cores for chemical analysis using the following field screening parameters:

    Magnetic susceptibility
    Correlation of layers of interest with relative periods of deposition
    Visual observations
    Grain size

  Analyze the selected samples for PAH, PCB, pesticides, bulk metals, TOC, butyltins and grain size distribution.

- Collect ten sediment samples from the wetlands north and south of the landfill at the locations shown on Figure 3-3. Analyze the samples collected at each location for sediment toxicity bioassay (using <u>Ampelisca</u> or other appropriate amphibod species), pore water toxicity (using <u>Arbacia</u>), SEM/AVS, grain size, TOC, and bulk chemistry.

- Evaluate VOC presence and concentration in deep ground water beneath the Allen Harbor Landfill for the purpose of evaluating potential mass loading into the harvor by conducting fate transport modeling of ground water and surface water:

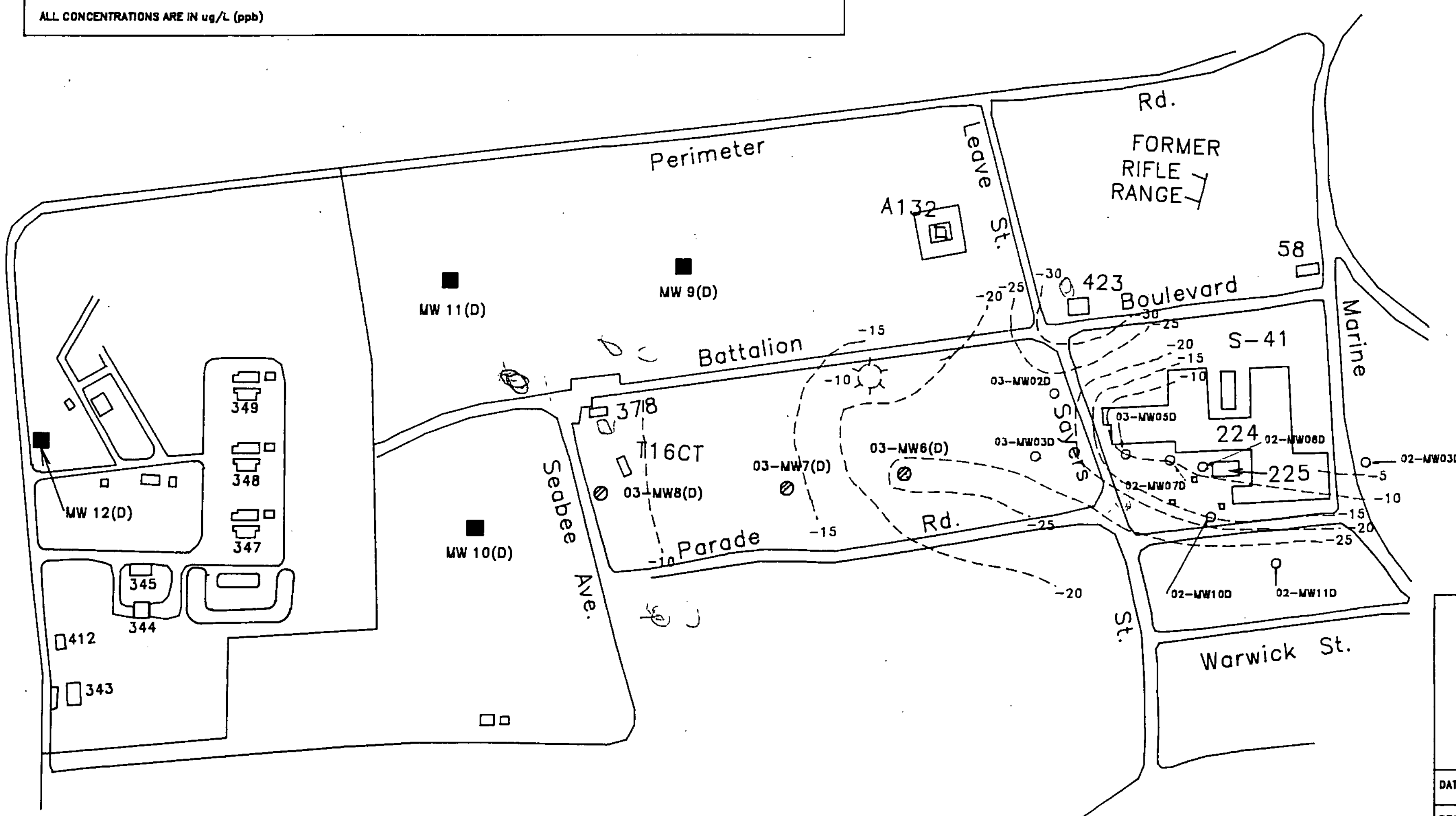
USEPA analytical Level I (field screening, using portable instruments), and Naval Environmental and Energy Support Activity (NEESA) Level D laboratory analyses will be used.

WELL NO.	1,2 DICHLOROETHENE (TOTAL)	TRICHLOROETHENE	1,1,2-TRICHLOROETHANE	1,1,2,2-TETRACHLOROETHANE
02-MW03D	14	--	--	--
02-MW07D	51	75	15	--
02-MW08D	--	--	--	--
02-MW10D	27	10	10	--
02-MW11D	9J	--	--	--
03-MW02D	--	--	--	--
03-MW03D	120	210	9J	100
03-MW05D	--	--	--	--
03-MW06D	290	1,000	22J	410
03-MW07D	210	680	20J	310
03-MW08D	1,000	4,000	82J	2700

J = ESTIMATED CONCENTRATION

-- = NON DETECT

ALL CONCENTRATIONS ARE IN ug/L (ppb)



NOTE: BEDROCK SURFACE ELEVATION INTERPRETED FROM BORING LOGS, GEOLOGIC CROSS SECTIONS, AND AT SELECTED POINTS ALONG GEOPHYSICAL SEISMIC LINE CROSS SECTIONS (TRC, 1993 AND TRC, 1994).

LEGEND

-----.$^{-10}$ INTERPRETIVE BEDROCK SURFACE CONTOUR IN FEET BELOW MSL

○ EXISTING MONITORING WELL (PHASE I REMEDIAL INVESTIGATION)

⊘ EXISTING WELL (SUPPLEMENTAL PHASE II REMEDIAL INVESTIGATION)

■ PROPOSED WELL

SCALE in FEET (Approximate)

400 300 200 100 0 400

PHASE III RI — NCBC-DAVISVILLE, RHODE ISLAND

FIGURE 3-1

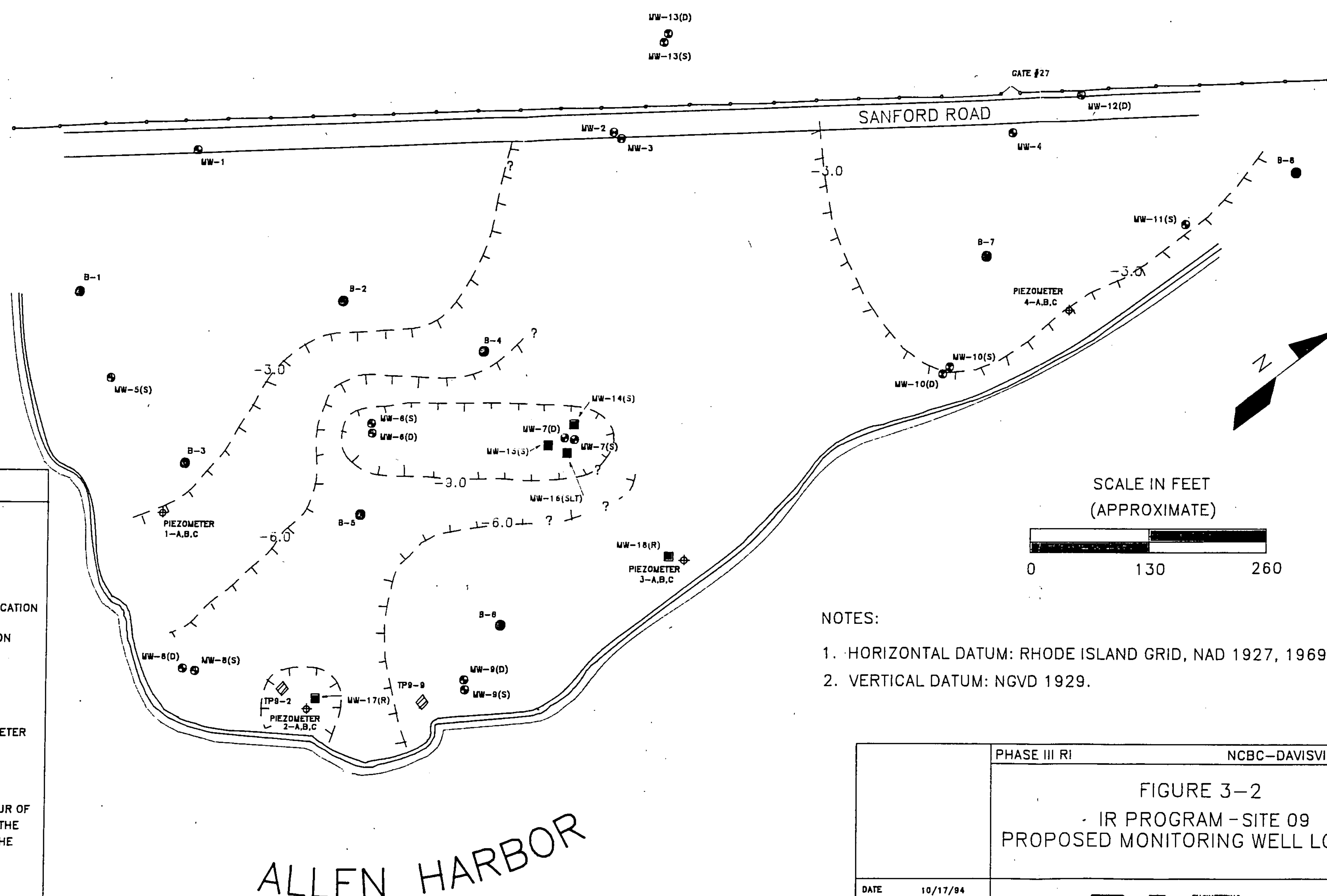
IR PROGRAM - SITE 03
PROPOSED MONITORING WELL LOCATION MAP

DATE	10/17/94
DESIGNED BY	GML
DRAWN BY	JMF
CHECKED BY	NAL
PROJECT MANAGER	NAL

EA ENGINEERING SCIENCE AND TECHNOLOGY

SHARON COMMERCE CENTER
2 COMMERCIAL STREET, SUITE 106
SHARON, MASSACHUSETTS 02067
(617) 784-1767

PROJECT NUMBER	29600.32
SCALE	1"=400'
FILE NAME	A:\davis.dwg
DRAWING NUMBER	
SHEET NUMBER	1 OF 1



NOTES:

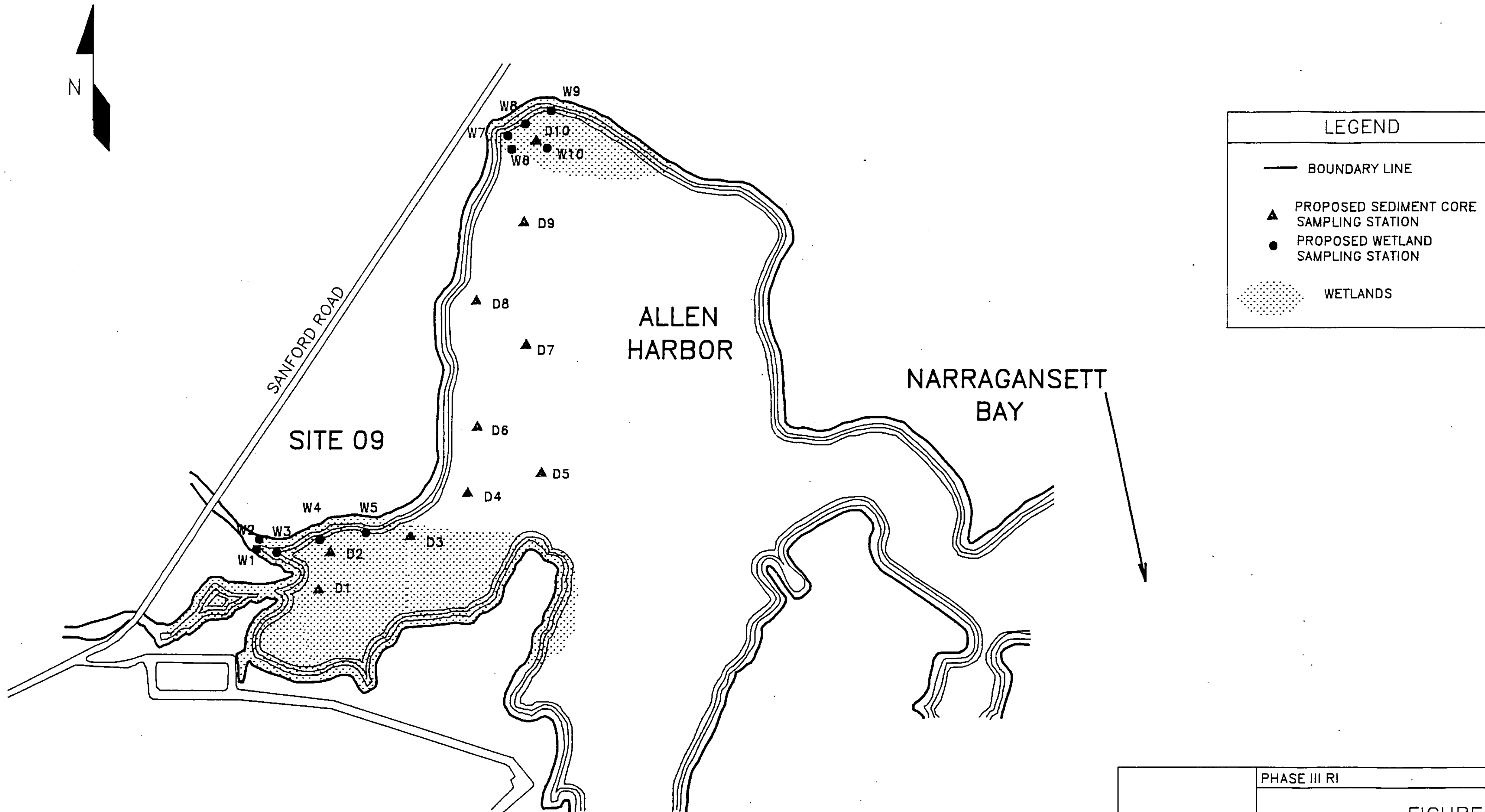
1. HORIZONTAL DATUM: RHODE ISLAND GRID, NAD 1927, 1969 ADJUSTMENT.
2. VERTICAL DATUM: NGVD 1929.

LEGEND

- (S) .... SHALLOW
- (D) .... DEEP
- (SLT) .... SILT
- (R) .... BEDROCK
- .... MONITORING WELL LOCATION
- .... TEST BORING LOCATION
- (S) .... SHALLOW WELL
- (D) .... DEEP WELL
- .... MULTI-LEVEL PIEZOMETER
- .... TEST PIT LOCATION
- .... INTERPRETIVE CONTOUR OF EQUAL ELEVATION OF THE UPPER SURFACE OF THE GRAY SILT UNIT
- .... PROPOSED BORING/ WELL LOCATIONS

SOURCE: BASE MAP MODIFIED FROM FIGURES 2-2 AND 2-3 OF THE TRC DRAFT ALLEN HARBOR LANDFILL REMEDIAL INVESTIGATION REPORT, VOLUME 1, NOVEMBER 1993.

PHASE III RI	NCBC-DAVISVILLE, RHODE ISLAND	
FIGURE 3-2 IR PROGRAM - SITE 09 PROPOSED MONITORING WELL LOCATION MAP		
DATE 10/17/94	EA ENGINEERING SCIENCE AND TECHNOLOGY	PROJECT NUMBER 29600.32
DESIGNED BY GML		SCALE AS SHOWN
DRAWN BY GML		FILE NAME A:FIG3-2
CHECKED BY NAL	SHARON COMMERCE CENTER 2 COMMERCIAL STREET, SUITE 108 SHARON, MASSACHUSETTS 02067 (617) 784-1767	DRAWING NUMBER
PROJECT MANAGER NAL		SHEET NUMBER 1 OF 1



PHASE III RI — NCBC–DAVISVILLE, RHODE ISLAND

FIGURE 3–3

IR PROGRAM – SITE 09
PROPOSED SEDIMENT CORE & WETLAND
SAMPLING STATION MAP

DATE	10/21/94
DESIGNED BY	GML
DRAWN BY	GML
CHECKED BY	NAL
PROJECT MANAGER	NAL

EA ENGINEERING SCIENCE AND TECHNOLOGY

SHARON COMMERCE CENTER
2 COMMERCIAL STREET, SUITE 106
SHARON, MASSACHUSETTS 02067
(617) 784–1767

PROJECT NUMBER	29600.32
SCALE	NOT TO SCALE
FILE NAME	A:FIG3–3
DRAWING NUMBER	
SHEET NUMBER	1 OF 1

4.0 QUALITY ASSURANCE PROJECT PLAN

4.1 PROJECT DESCRIPTION

Note: Information presented in the Quality Assurance Project Plan (QAPP) was taken from the QAPP for the Phase II RI/FS Work Plan prepared by TRC and has been modified to reflect current conditions. The QAPP for the Ecological Risk Assessment is presented in Appendix C of this work plan and in Draft Work/Quality Assurance Project Plan for Narragansett Bay Ecorisk and Monitoring for Navy Sites, prepared by URI and SAIC, dated 12 July 1994.

4.1.1 Introduction

This Quality Assurance Project Plan has been developed for use in conjunction with sampling activities at the Naval Construction Battalion Center in Davisville, Rhode Island. The sampling program builds on findings and recommendations of previous studies conducted at NCBC-Davisville. Previous studies included; an IAS conducted in 1984, Confirmation Study- Characterization Step study, which was completed in 1987, the Phase I Remedial Investigation which was completed in 1991, the Phase II and Supplemental Phase II Remedial Investigations which were completed in mid 1994.

Navy policy calls for following EPA guidance and procedures while conducting investigations and remedial action at all Navy waste sites. The specific tasks outlined in the current Navy IR Program are consistent with EPA guidance, and provide a structure for conducting an RI/FS based on the National Contingency Plan (NCP).

The QAPP serves as a controlling mechanism during field sampling to ensure the data collected are valid, reliable, and legally-defensible. The QAPP outlines the organization, objectives, and all Quality Assurance/Quality Control (QA/QC) activities which will ensure achievement of desired data quality goals.

4.1.2 Base Description and History

NCBC Davisville is located in the northeast section of the Town of North Kingstown, Rhode Island, approximately 18 miles south of the state capital, Providence. NCBC Davisville is composed of three areas: the Main Center, the West Davisville storage area, and Camp Fogarty, a training facility located approximately 4 miles west of the Main Center (Figure 1-2). A significant portion of NCBC Davisville is adjacent to Narragansett Bay. Adjoining NCBC Davisville Main Center's southern boundary is the decommissioned Naval Air Station (NAS) Quonset Point, which was transferred by the Navy to the RIPA in April 1973 (TRC, 1994). Land use surrounding NCBC Davisville is predominantly residential to the north and south (Environmental Baseline Survey, 1993). West of the Main Center along Route 1, development consists of shopping malls, retail stores, restaurants, and gas stations.

The Davisville/Quonset Point area was originally settled by Europeans in the late 17th century. Quonset Point was the location of the first annual encampment of the Brigade Rhode Island Militia in 1893. During World War I, it was a campground for the mobilization and training of troops and later, the home of the Rhode Island National Guard. In the 1920s and 1930s, it was used as a summer resort for local residents.

In 1939, Quonset Point was acquired by the Navy and construction began in 1940. During construction, millions of cubic yards of sediment were dredged to create the ship basin and channel. The dredged material was used to create a 1.5 mile section in Quonset's northeast corner. Wartime activities at Naval Air Station (NAS) Quonset Point included training aircraft carrier pilots and crews, overhauling aircraft, supplying military equipment and planes, and providing coastal defense.

By 1942, the operations at NAS Quonset Point had outgrown the station. Adjacent land at Davisville was designated as the Advanced Base Depot. Later that year, the Naval Construction Training Center (NCTC), known as Camp Endicott, was established at Davisville to train newly established construction battalions. By November 1942, the camp was at capacity, housing 15,000 enlisted men and 350 officers. Over 100,000 service members were trained at Camp Endicott by the end of World War II.

"The NCBC-Davisville area was inactive between World War II and the Korean Conflict. In 1951, it became the Headquarters Construction Battalion Center. The Construction Battalion Center loaded ships and trained men for both the Korean and Vietnam conflicts. In 1974, the NAS and Naval Air Rework Facility at Quonset Point were decommissioned and operations at Davisville were greatly reduced. In 1989, the closure of Davisville was announced, and all operations at Davisville were phased down to the present staffing levels for Public Works, Maintenance, Security, and Navy Personnel. NCBC Davisville was closed effective April 1, 1994, at which time the staff at NCBC was reduced to a caretaking work force of eight to maintain base security and oversight of maintenance and environmental projects." (TRC, 1994)

4.1.3 Previous Site Investigations

4.1.3.1 IR Program Site 03 - Solvent Disposal Area

IR Program Site 03 is located immediately west of Site 02, in the northern portion of NCBC Davisville (Figure 1-2). The Site consists of a flat and previously paved area, bounded by Sayers Street to the east, Parade Road to the south and Battalion Boulevard to the north (Figure 1-3). The surface of the site is characterized by deteriorated asphalt interspersed with grass.

From 1955 to the late 1970s, approximately 3,000 gallons of paint thinners and unidentified solvents were reportedly disposed on the ground west of Sayers Street and Building 224. While the precise limits of the disposal area are not known, disposal is thought to have occurred in an area adjacent and west of Sayers Street. A portion of the Site was also used for heavy equipment storage. The area further west was reportedly used to store and maintain vehicles. (TRC 1994)

Previous site investigations include: an Initial Assessment Study (IAS) by Fred C. Hart Associates, completed in 1984; a Confirmation Study-Verification step, completed by TRC in 1987; Confirmation Study-Characterization Step, completed by TRC in 1988; and a Phase I Remedial Investigation (RI) completed by TRC in 1991. A Phase II RI, completed by TRC in 1992, was performed to further delineate the horizontal and vertical extent of contamination associated with the solvent disposal area. To further delineate the VOC detected in monitoring well 03-MW-3D (Figure 2-1) during the Phase II RI, TRC conducted a Supplemental Phase II Field Investigation in March 1994.

In general, surface and subsurface soil and shallow ground water reportedly appeared to be minimally impacted by the reported solvent disposal activities. A total of 27 surficial soil samples were collected within Site 03's limits during the Phase I and II RI's. Acetone, toluene and chloroform were detected. TRC (1994) concluded that based on the low concentrations and infrequency of detection, that the reported concentrations may be due to laboratory contamination. Chloroform was detected at 2 ppb in one of two subsurface samples collected during the Phase I RI. Acetone at 20 ppb was reported in only 1 of 12 subsurface soils samples collected and analyzed during the Phase II RI (TRC, 1994). No VOC were detected in samples collected from wells screened at the water table.

VOC were reported in samples collected from wells screened at the bottom of the unconsolidated material. Maximum reported concentrations of detected compounds are: 1,2-dichloroethene at 1000 ppb, trichloroethene at 4,000 ppb, 1,1,2-trichloroethane at 82 ppb, and 1,1,2,2-tetrachloroethane at 2,700 ppb (Figure 2-1).

4.1.3.2 IR Program Site 09 - Allen Harbor Landfill-Remedial Investigation

Site 09 covers an area of approximately 13.5 acres along the western side of Allen Harbor. The landfill is bounded to the east and south by Allen Harbor and to the west by Sanford Road (Figures 1-2 and 1-4). A marsh is located to the west of the landfill, on the opposite side of Sanford Road, at the edge of the Navy property. Access to the landfill is controlled by a fence with locked gate at the Sanford Road entrance. The landfill is currently overgrown by shrubs, small trees, and grasses. Substantial amounts of building debris and rusted metallic objects are visible at various locations across the site. Cover materials at the landfill consist of poorly sorted sand and gravel with silt and clay. The cover is non-uniform over the landfill, varying in depth from one to three feet in thickness. (TRC, 1994)

From 1946 to 1972, the Allen Harbor Landfill was used for the disposal of waste generated at NCBC Davisville and NAS Quonset Point. A large variety of waste, including large quantities of preservatives, paint thinners, degreasers, PCB, asbestos, ash, sewerage sludge, 55-gallon drums, used mineral grit, and contaminated fuel oil may have been placed in Allen Harbor Landfill.

Previous site investigations include: an Initial Assessment Study (IAS) by Fred C. Hart Associates completed in 1984; a Confirmation Study-Verification Step completed by TRC in 1987; a Phase I Remedial Investigation completed by TRC in 1991; and a Phase II and Supplemental Phase II Remedial Investigation completed by TRC in 1994.

The objective of the Phase II Remedial Investigation was to further delineate the vertical and horizontal extent of the contamination through a series of test and sampling rounds including:

- Seismic refraction survey.
- Electromagnetic conductivity survey.
- Magnetometry survey.
- Soil and sampling.
- Installation of wells and piezometer clusters.
- Conductivity testing.

The result of the Phase II RI indicated the need for a limited supplemental investigation at the site. Three soil samples and samples were collected to determine the salinity across the site and to determine the potential for contaminants to leach from the subsurface soil.

Surface and subsurface soil sampling and analyses identified numerous volatile organic compounds at Site 09. These include the following:

Compound	Maximum Reported Concentration (ppb)
Benzene	3
Ethlybenzene	220
Toluene	82
Xylene	4500
1,1,2,2-Tetrachloroethane	640
Trichloroethene	670
1,1,2-Dichloroethene	3100
1,1,1-Trichloroethane	350
Vinyl Chloride	350
Chlorobenzene	190
Acetone	180
2-Butanone	11
Methylene chloride	88

VOC were also detected in samples collected from wells screen at the water table including:

Compound	Maximum Reported Concentration (ppb)
1,2-Dichloroethene	510
Vinyl Chloride	25
1,2-Dichloropropane	940
Trichloroethene	74

Tetrachloroethene	670
Benzene	11
Toluene	28
Ethylbenzene	87
Xylene	190
Chlorobenzene	620

Highest total VOC-concentration (2000 ppb) was reported in MW-6S (Figure 2-2).

In the silt unit, significant total VOC-concentration (44,250 ppb) was detected only in the sample collected from MW-7D. Total VOC concentrations were significantly less in the samples collected from MW-3D (122 ppb), MW-8D (10 ppb), MW-9D (398 ppb) and MW-13D (2 ppb). No VOC were detected in MW-6D, MW-10D, and MW-12D. (Figure 2-3).

4.1.3 Ecological Risk Assessment-Allen Harbor

A marine ecological risk assessment was undertaken at the Naval Construction Battalion Center, Davisville, Rhode Island to determine the effects of hazardous waste disposal on Allen Harbor and Narragansett Bay. A phased approach was developed involving site characterization (Phase I), assessment of contaminant exposure and biological effects (Phase II) and quantification of ecological risks (Phase III). Phase I study results showed no major environmental problems unique to Allen Harbor, but did raise questions regarding some aspects of sediment and water quality.

Phase III investigations focused on relative importance and seasonal dynamics of specific contaminant sources including the landfill, surface runoff and marina activities. The study found that runoff and landfill sources were important sources of pollution input into the harbor, whereas marina sources were not. Polluntant source strength was greater for landfill than runoff exposure routes based on tissue residues in indigenous bivalves, with metals and pesticides being highest in spring and summer, respectively. Toxicity testing showed negative impacts due to both surface runoff and in sediments adjacent to the landfill and were not seasonally dependent.

Phase II investigations involved the development of exposure-response models and their application to estimation of ecological risk. Results indicated that the likelihood of biological impairment for species indigenous to Allen Harbor was about 1-in-5 for sea urchin (*Arbacia*) fertilization, and about 1-in-2 for sea urchin development, macro-algal reproduction (*Champia*) and larval clam development (*Mulinia*). Risks beyond immediate proximity to the landfill were not calculated but interpreted to be insignificant given a lack of direct toxicological effect observed in amphipod (*Ampelisca*) and bivalve (*Mulinia*) tests with these sediments. However, calculations suggested that significant risks are possible if contaminants contained in the sediment were to increase in bioavailability.

4.1.4 Current Site Investigations

The overall objective of the remedial investigation at Site 03 is to assess whether past Navy activities in the area located west (on what is now Rhode Island Port Authority property, but prior to 1974 was Navy property) and northwest of Site 03 may have contributed to the volatile organic compounds (VOC) detected in the deep ground water west (upgradient) of Site 03 between Seabee Avenue and Sayers Street.

The objectives of the remedial investigation and ecological risk assessment at Site 09 are to evaluate: 1) the nature and extent of VOC in the lower portion of the upper (sand) aquifer in the vicinity of 09-MW-7D; 2) the nature of potential VOC in the deep ground water (silt unit and bedrock aquifer); 3) the impact of potential VOC in the deep ground water migrating from beneath the landfill toward, and discharging into the bottom sediment of Allen Harbor on the bottom dwelling (benthic) and near bottom dwelling (pelagic) marine organisms, and if appropriate, through the food chain; 5) the impact the bringing sediment from below the zone of bioturbation in Allen Harbor into contact with sediment in the zone of bioturbation and the water column resulting from clamming, dredging, or storm surges and 6) the ecological impact of the landfill on the salt water marsh/wetlands to the north and south of the landfill.

The purpose of this workplan is to present the tasks and procedures, (i.e., field investigation, sample analysis, data evaluation, and risk assessment), necessary to accomplish the project objectives.

Site 03 tasks include the following:

1. Install four monitoring wells to the top of bedrock upgradient of Site 03 on the RIPA property.

2. Collect split spoon soil samples as the soil borings for the monitoring wells are drilled, and screen the soil headspace for VOC using a portable gas chromatograph. Based on the headspace screening results, select two soil samples from each soil boring and submit the samples for laboratory analysis for Target Compound List (TCL) VOC.

3. Collect a sample from each of the four wells and analyze the samples for TCL VOC.

4. Measure and record the depth to the water table in each of the wells located in Sites 02 and 03.

5. Evaluate the data collected during the subsurface investigation, with regard to possible source areas, the bedrock surface configuration, and the direction of flow.

Site 09 tasks include the following:

1. Install two monitoring wells in the lower portion of the upper aquifer and one well in the silt unit in the area of 09-MW-7D to assess the nature of VOC in the ground water and whether "pooled DNAPL" is present.

2. Drill two borings into bedrock and complete them as monitoring wells. Recover rock core from and perform packer testing in the boreholes in order to estimate aquifer parameters to be used in the fate-transport model.

3. Select and analyze up to two soil samples from each test boring for laboratory analysis of TCL VOC. Sample selection will be based on soil headspace screening results using a PID.

4. Collect samples from nine wells, the five wells described in 1 and 2 above, as well as 09-MW-6D, 09-MW-8D, 09-MW-9D and 09-MW-10, and analyze the samples for TCL VOC.

5. Monitor fluctuations in the elevation of the water table and changes in salinity over several tidal cycles to aid in the evaluation of the hydraulic relationship between the aquifers which underlie the site.

6. Collect samples of sediment at each wetlands sampling station (Figure 3-3), (the top 2 cm of sediment) for sediment toxicity bioassays (using *Ampelisca* or other appropriate amphipod species), pore water toxicity tests (using *Arbacia*), SEM/AVS analysis, grain size and TOC determinations, and bulk chemistry analysis.

   Collect sediment cores (approximately 1-2 M in length) at the wetland and Allen Harbor sampling stations (Figure 3-3). Scan each replicate core for magnetic susceptibility to determine the representative core (for each sampling station) to be selected for analysis of bulk metals, PAH, PCB, pesticides, and butyltins, grain size, and total organic carbon.

7. Perform fate-transport modeling of VOC in the bedrock.

8. Perform an ecological risk assessment of deep sediment in Allen Harbor.

9. Prepare remedial investigation and ecological risk assessment reports.

The planned field investigation activities for each site are presented in the Field Sampling Plan provided in Chapter 3 of this Work Plan. The sample program may include use of Target Compound List (TCL) for Volatile Organic Compounds (VOC) and Target Analyte List (TAL) analyses using EPA-CLP protocols, as defined in the U.S. EPA Contract Laboratory Program (CLP) Statement of Work (SOW) for Organic Analysis; Multi-Media, Multi-Concentration; SOW No. 3/90; revised July 1991, and in the U.S. EPA CLP SOW for Inorganic Analysis; Multi-Media, Multi-Concentration; SOW No. 3/90; revised September

1991. These requirements will be followed during this study. Naval Energy and Environmental Support Activity (NEESA) guidance for Level D analyses and data validation will also be followed (*Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program*, NEESA 20.2-047B, 1988). Where EPA-CLP protocols and NEESA guidance differ, the more stringent requirements will be followed.

4.2 PROJECT QA/QC ORGANIZATION AND RESPONSIBILITIES

4.2.1 Introduction

This project will be largely performed by EA Engineering, Science, and Technology. The names and addresses of select individuals involved in the project appear below.

- **U.S. Navy**

  Northern Division Code 1823
  Naval Facilities Engineering Command
  10 Industrial Highway, Mail Stop #82
  Lester, Pennsylvania 19113

  Mr. Robert Krivinskas
  Remedial Project Manager
  (610) 595-0567 ext. 134

  Caretaker Site Office
  Naval Construction Battalion Center
  Building 404
  Davisville, Rhode Island 02854

  Mr. Louis Fayan
  (401) 294-6108

- **EA Engineering**

  2 Commercial Street (Suite 106)
  Sharon, Massachusetts 02067
  (617) 784-1767

  Mr. Nicholas A. Lanney, P.E.
  CTO Manager
  (617) 784-1767

  Mr. Robert Cypher
  QA Manager
  (410) 584-7000

- **Laboratory**:

  IEA Laboratories Inc.
  200 Monroe Turnpike
  Monroe, CT 06468
  Phone: (203) 261-4458

The EA QA Manager will initiate and monitor any necessary formal corrective actions. He will assist in preparing QA/QC project summaries for the Final Report, including analysis of precision, accuracy and completeness of data collected.

4.2.4 Field QC Coordinator's Responsibilities

A Field QC Coordinator will be selected for this project. The Field QC Coordinator will work with the field team during preparations for the sampling events, and also during conduct of field work. He or she will be on site to ensure required QC procedures are followed for sample collection and drilling; will initiate informal and/or formal corrective actions, as necessary; and will maintain and report OC records and results to the EA CTO Manager and QA Officer. The QC field coordinator will also serve as the QA/QC Manager for the project. This person will be responsible for ensuring all analytical deliverables have been received and subsequently validated in accordance with this QAPP.

4.2.5 Laboratory QC Coordinator

IEA Laboratories, the analytical laboratory selected for this project, a NEESA-approved laboratory, will also designate a QC Coordinator who will function as part of the project QC team. The exact duties of the laboratory QC Coordinator will include, at a minimum, the following:

- Direct preparation of sample containers.
- Direct preparation and inclusion of blind OC samples in sample load in a fashion unrecognizable to analysts.
- Monitor use of known QC samples, blanks and duplicates, as required by specific projects.
- Maintain records of performance on known and blind OC samples as a measure of analytical precision and accuracy (control charts, etc.).
- Direct and monitor recordkeeping and sample tracking activities.

4.3 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

4.3.1 Introduction

The overall quality assurance objective for laboratory analysis of environmental samples is to provide a laboratory QA/QC program that is, at a minimum, equal to the U.S. EPA Contract Laboratory Program. The quality control limits of accuracy and precision for laboratory analyses are governed by the methods and equipment used. Laboratory QA/QC requirements defined in CLP protocol are designed to ensure that acceptable levels of data accuracy and precision are maintained throughout the analytical program. These requirements are detailed in the U.S. EPA CLP Statement of Work (SOW) for Organic Analysis; Multi-Media, Multi-Concentration; SOW No. 3/90; revised August 1991 and in the U.S. EPA CLP SOW for Inorganic Analysis; Multi-Media, Multi-Concentration; SOW No. 3/90; March 1990. These requirements will be followed during this study.

It must be recognized that QA objectives may be attainable only for samples that are homogeneous and do not have inherent matrix-related problems. In the event that QA objectives cannot be met on specific samples, groups of samples or sample types, the analytical laboratory will make every reasonable effort to determine the cause of non-attainment and, if such is due to instrument malfunction, operator error, or other identifiable cause within the control of the laboratory, the samples affected will be reanalyzed, if possible. Should non-attainment of QA objectives be due to sample inhomogeneity, sample matrix interference or other sample-related causes, reanalyses will be treated as additional analyses.

For many EPA-approved methods, interlaboratory method verification studies have been used to establish QC criteria which may be regarded as an inherent part of the method. In those cases, such criteria will take precedence except for deviations from such criteria that can be reasonably attributed to sample-related cases. The quality assurance objectives for all measurement data include considerations of precision, accuracy, completeness, representativeness, and comparability as described below.

4.3.2 Precision and Accuracy

The precision of a measurement is an expression of mutual agreement of multiple measurement values of the same property conducted under prescribed similar conditions. Precision reflects the repeatability of the measurement. Precision is evaluated most directly by recording and comparing multiple measurements of the same parameter on the same sample under the same conditions. Precision is usually expressed in terms of the standard deviation. The precision objectives for analytical parameters are specified in the CLP protocols. Except as otherwise specified by the method, the QC objective for precision under this project will be +20 percent (relative percent difference) as determined by duplicate analyses. It must be recognized that for analytes at concentrations of less than five times the method detection limit (MDL), this objective is unlikely to be met.

The degree of accuracy of a measurement is based on a comparison of the measured value with an accepted reference or true value, or is a measure of system bias. Accuracy of an analytical procedure is best determined based on analysis of a known or "spiked" sample quantity. The degree of accuracy and the recovery of analyte to be expected for the analysis of QA samples and spiked samples is dependent upon the matrix, method of analysis, and compound or element being determined. The concentration of the analyte relative to the detection limit is also a major factor in determining the accuracy of the measurement. Except as otherwise specified by a method, the QC objective for accuracy under this project will be 75 to 125 percent (percent recovery), as determined by sample spike recoveries. Alternately, accuracy may be assessed through the analyses of appropriate standard reference materials, certified standards, or samples, as available.

4.3.3 Completeness

Completeness is a measure of the amount of valid data obtained from the measurement system relative to the amount anticipated under ideal conditions. This project's QC objective for completeness, as determined by the percentage of valid data generated, will be >90 percent.

4.3.4 Representativeness

Samples taken must be representative of the population. Where appropriate, the population will be statistically characterized to express: (1) the degree to which the data accurately and precisely represent a characteristic of a population, (2) parameter variations at a sampling point, and (3) a process, or an environmental condition. Sample selection and handling procedures will be conducted to obtain the most representative sample possible. Sampling devices will be decontaminated between sampling points to ensure that cross-contamination does not occur between samples. Representativeness will also be monitored by collection and analysis of the following QC field samples:

- Trip blanks.
- Field blanks.
- Source water blanks.
- Duplicate samples.

These QC samples will be collected in accordance with Section 4.4.4 of the QAPP. Representative samples will be collected through the following actions:

- Collect samples from locations fully representing the site conditions.
- Use appropriate sampling procedures and equipment.
- Use appropriate analytical methodologies.
- Analyze for appropriate parameters using appropriate detection limits.

Field duplicate and field blank samples will be shipped as blind samples to the laboratory. These samples will be numbered similarly to other samples except fictitious sample identifiers will be assigned. Trip blanks will be labelled as such and shipped with samples being analyzed for volatile organics. Samples for matrix spike and matrix spike duplicates will be designated on the chain-of-custody forms and sample labels. Samples for matrix spike and matrix spike duplicate analyses for organic parameters will be collected in triplicate; samples for matrix spike analyses for inorganic parameters will be collected in duplicate.

The laboratory will make appropriate efforts to assure that the samples are adequately homogenized prior to taking aliquots for analysis, so reported results represent samples received. Some techniques of homogenization (e.g., compositing) expose the sample to significant risk of contamination or loss through volatilization, and will be avoided.

4.3.5 Comparability

Consistency in sample acquisition, handling, analysis and level of QA/QC is necessary so that the results may be compared. Where appropriate, the results of the analyses will be compared with the results obtained in previous studies. The laboratory will use EPA-approved methods and reporting units, in order to assure that the data will be comparable to other similarly generated data sets.

4.4 SAMPLING PROCEDURES

Note: The anticipated field activities will utilize TCL VOC analysis. Descriptions of additional analyses are provided in the event that additional sampling parameters are required.

4.4.1 Introduction

Soil and ground water will be sampled during the Phase III field investigation study at NCBC-Davisville. Sample collection and monitoring procedures are presented in the Field Sampling Procedures (Appendix B of this Work Plan). These procedures will be implemented in order to collect representative data for remedial planning guidance. All sample media collected will be handled in accordance with this Quality Assurance Project Plan and the Field Sampling Procedures. All analytical methods and estimated detection limits are subsequently described in Section 4.7 of this document, including analysis for the TCL and TAL, as well as all other parameters for this project.

4.4.2 Selection of Sampling Locations

The locations of samples for each of the sites at NCBC-Davisville appear in the Field Sampling Plan in Chapter 3 of the Work Plan, Figures 3-1, 3-2 and 3-3.

4.4.3 Sample Collection, Handling, and Shipping

It is important to use appropriate sample containers so that no chemical alteration occurs between the collection of samples in the field, and the receipt of samples at the laboratory. The sample bottles will be prepared and shipped to the field by the laboratory, under the direction of the laboratory QC Coordinator. The sample bottles will be transported to the site within a sealed shipping cooler.

Sample containers will be selected to ensure compatibility with the potential contaminants and to minimize breakage during transportation. Aqueous phase samples for organic analyses will be contained in glass vials with teflon-lined, screw-type caps. Sample bottles, analytical methods and preservation required are listed in Table 4-1 for soil and sediment samples and in Table 4-2 for aqueous samples. Holding times are further defined in Table 4-3, for the analytical methods listed in Tables 4-1 and 4-2.

Sample labels will be filled out at the time of sampling and will be affixed to each container to identify the sample number, collector's name, date and time of collection, location of the sampling point, preservatives added, and analyses requested for sample.

Samples will be analyzed for total metals and consequently filtering will not be conducted in the field prior to the addition of preservatives. Water samples to be analyzed for cyanide will be checked in the field for the presence of chlorine using potassium iodide (KI) starch paper. If chlorine is present, ascorbic acid will be added until the KI paper indicates that no chlorine is present.

After the bottles for a given sample site have been filled, they will be placed in a shipping cooler. Samples to be analyzed for volatile organics will not be shipped in the same cooler with samples submitted for total petroleum hydrocarbon analysis. Samples requiring preservation at 4°C will be covered with crushed ice in plastic bags or ice packs and placed in a separate cooler. Field personnel will provide crushed ice or ice packs to add to the shipping coolers as the samples are collected. Each sample container will be cushioned and sealed in a cooler container for shipment to the laboratory by overnight delivery. Daily sample collection activities will be scheduled in order to assure overnight delivery.

A chain-of-custody record will be prepared and will accompany all samples to provide documentation of all samples collected and to trace sample possession. Chain-of-custody procedures are discussed in detail in Section 4.5 of this document.

4.4.4 Field Quality Control (QC) Samples

Table 4-4 lists the percentage of field QC samples per sample matrix for the Level D analyses, based on current Navy NEESA guidance. A sampling event is defined as the time from which the sampling personnel arrive at the site until these personnel complete the sampling task.

An example of two events would occur if sampling personnel went to a site for three weeks, drilled borings, and installed monitoring wells. During this task, soil and water samples were collected for laboratory analysis. The sampling crew subsequently left the site for two months, thus concluding the first sampling event. The crew later returned to collect another set of samples over a three day period. The second visit would constitute the second sampling event.

Trip blanks, field blanks, and duplicate samples will be collected as part of each sampling event, in order to ascertain a measure of quality control during each sampling round. The following sections describe the purpose and usage of each of these types of samples.

4.4.4.1 Trip Blanks

Trip blanks are defined as samples which originate as analyte-free water which is placed in volatile organic vials (preserved with HCl) in the laboratory and shipped to the site with the field sampling kit. These vials are subsequently returned to the laboratory with the volatile organic (VOA) samples. One trip blank will accompany each cooler containing water samples to be analyzed for VOA, and will be stored at the laboratory with the samples. Trip blanks will be analyzed in order to evaluate the effect of ambient site conditions and sample shipment on sample integrity, and to ensure proper sample container preparation and handling techniques. All trip blanks will be labeled according to the proper chain-of-custody procedures and will be analyzed for volatile organic compounds.

4.4.4.2 Field Blanks

Field blanks will be collected in order to determine the effectiveness of the decontamination of sample collection equipment. The field blank will be collected by pouring laboratory-supplied, analyte-free deionized water directly over the decontaminated sample collection equipment (i.e., bailer, stainless steel spoon, etc.) and into the appropriate sample containers. Field blanks will be collected for each matrix sampled. All field blanks will be analyzed for the same analytical parameters as the sample matrix. A minimum of one field blank will be collected for every 20 samples or a minimum of one field blank per day per matrix will be collected. All field blanks will be preserved in accordance with the methods specified in Table 4-2, labeled according to the proper chain-of-custody procedures, and stored and shipped according to the procedures discussed previously.

4.4.4.3 Source Water Blanks

Source water blanks consist of the source water (obtained from NCBC-Davisville water supply) used during decontamination (e.g., steam cleaning). At a minimum, one source blank from each source of water will be collected and analyzed for the same parameters as the related samples. In addition, samples of the distilled water used in decontamination will also be tested.

4.4.4.4 Field Duplicates

Duplicate samples will be collected, homogenized, and split. The procedure for collecting duplicate samples consists of alternating the collection of the sample between the sample collection bottle and the duplicate collection bottle. Samples for VOC analyses will not be mixed, but equal portions of the sample will be collected simultaneously and placed in appropriate containers listed in Table 4-1 and 4-2. Field duplicates will be collected at a frequency of ten percent per sample matrix (NEESA - Level D). All duplicate samples will be sent to the primary laboratory responsible for analysis.

4.4.4.5 Regulatory Splits

If regulatory agencies (state or federal) wish to obtain samples for independent analysis which are duplicates of those collected by EA, these regulatory split samples will be collected in the same manner as field duplicates but will be sent by the regulatory agency to a separate, independent laboratory for analysis.

4.4.5 Field Decontamination Procedures

Drill rigs will be steam cleaned and drilling equipment will be decontaminated prior to moving to a site. Drilling equipment used for multiple boreholes will be decontaminated prior to each boring at the site. All decontamination of drill rigs and drilling equipment (e.g., augers, rods) will be conducted at designated decontamination areas with a steam cleaner.

Decontamination of sampling equipment will be performed at each site. Sampling equipment such as split-spoons, stainless steel spoons or spatulas and stainless steel mixing pans will be decontaminated using the following procedures described in Section 7.1 of the Appendix B, Field Sampling Procedures.

A drilling sequence hierarchy (from less likely to more likely contaminated boring locations) will be imposed to reduce the potential for cross-contamination. Sampling equipment will be decontaminated prior to use at each sampling location. Decontamination rinsates will be collected and contained in drums for subsequent determination of proper handling and/or disposal.

4.5 SAMPLE CUSTODY

4.5.1 Introduction

Sample custody procedures will be observed to ensure the validity of the data generated during this program. Sample chain-of-custody will be initiated with selection and preparation of the sample containers. To reduce the chance for error, the number of personnel handling samples will be restricted, and one person will be assigned the responsibility of field sample custodian.

Onsite monitoring data will be controlled and entered daily in permanent log books, as appropriate. Personnel involved with the sample chain-of-custody process will be trained in sample collection and handling procedures prior to project initiation.

4.5.2 Field Sample Custody

Sample custody and documentation procedures described in this section will be followed throughout all sample collection activities at NCBC-Davisville. Components of sample custody procedures include the use of field notebooks, sample labels, and chain-of-custody forms.

4.5.2.1 Field Notebooks

The EA CTO Manager will control all field notebooks. Each field notebook will receive a serialized number and be issued to the field team leader. Field notebooks will be bound books, preferably with consecutively numbered pages, that are at least 4 1/2 in. × 7 in. in size. Field notebooks will be maintained by the EA field team leader and other team members to provide a daily record of significant events, observations, and measurements during the field investigation. All notebook entries will be signed and dated.

All information pertinent to the field survey and/or sampling will be recorded in the notebooks. Field notebook entries will include the following information (at a minimum):

- Name and address of field contact.
- Name and title of author, date and time of entry, and physical/environmental conditions during field activity.
- Names and titles of field crew.
- Names and titles of any site visitors.
- Type of sampling activity.
- Location of sampling activity.
- Description of sampling point(s).
- Date and time of sample collection.
- Sample media (e.g., soil, sediment, , etc.).
- Number and volume of sample(s) taken.
- Analyses to be performed.
- Field observations.

- Calibration/Maintenance requirements of field instruments.
- References for maps and photographs of the sampling site(s).

Original data recorded in either the field notebooks, on sample labels, or in the chain-of-custody records will be written with waterproof ink. None of these accountable, serialized documents will be destroyed or discarded, even if they are illegible or contain inaccuracies.

If an error is made on an accountable document assigned to an individual, that individual will make all corrections by crossing a line through the error and entering the correct information and initialing and dating the cross-out. The erroneous information will not be obliterated. Any subsequent error discovered on an accountable document will be corrected by the person who made the entry, and will be initialed and dated, as appropriate.

4.5.2.2 Sample Labels

Once the sample is collected, label the appropriate sample bottle with the appropriate sample tag and provide the following data: sample identification number, project number and name, date, time, sampler's signature, number of containers per analyte, analysis requested, and preservative(s) added.

EA will employ the following coding (sample designation) system:

I. Soil Samples
Example: SB-01-1.0-3.0
>SB = Soil Boring
>First dash number from left to right indicates the location of the soil boring.
>Second dash number from left to right indicated the top of the sampling interval in feet.
>Third dash number from left to right indicates the bottom of the sampling interval in feet.

II. Samples
Example: MW-01
>MW = Monitoring Well
>First dash number indicates the position of the monitoring well.

III. Quality Assurance Samples
Example: MW-01QA
>A "QA" after the sample number designates a quality assurance sample. Quality assurance split will be identified both on the sample label, Chain-of-Custody. The QA designation will be followed by a sample designation (i.e. DUP, Field Blank, etc.)

4.5.2.3 Custody Seals

Each sample container will be sealed with a custody seal. Samples will be placed in sample coolers and the coolers sealed with custody seals prior to shipment to the laboratory. Clear adhesive tape will be placed over the seals only on the coolers to ensure that seals are not accidentally broken during shipment.

4.5.2.4 Chain-Of-Custody Records

All samples will be accompanied by a chain-of-custody record, an example of which is shown on Figure B-7 to Appendix B. A chain-of-custody record will accompany the sample from initial sample container selection and preparation commencing at the laboratory, to the field for sample containment and preservation, and through its return to the laboratory. If samples are split and sent to different laboratories, a copy of the chain-of-custody record will be sent with each sample.

The "Remarks" column in the chain-of-custody record will be used to record specific considerations associated with sample acquisition such as: sample type, container type, and sample preservation methods. When transferring samples, the individuals relinquishing and assuming sample custody will sign, date, and note the transfer time on the record.

Two copies of the chain-of-custody record and Cooler Receipt Form will follow each sample to the laboratory. The laboratory will maintain one file copy, and the completed original will be returned to the EA. A copy of the completed original will be returned as a part of the final analytical report. This record will be used to document sample custody transfer from the sampler, to another EA team member, to a shipper, or to the laboratory, and also to verify the date of sample receipt in the laboratory.

Shipments will be sent by overnight carrier with appropriate bill of lading documentation. Bills of lading will be retained as part of the permanent program documentation.

4.5.2.5 Sample Shipment

Samples will be delivered to the primary laboratory for analysis as soon as practical after the number of samples and sample containers is sufficient to comprise a shipment, preferably the same day the samples are collected. Sample shipment will occur at a minimum frequency of every other day. All samples will be stored in coolers at a temperature of 4°C. The samples will be accompanied by the chain-of-custody record. During sampling and sample shipment activities, the EA field team leader (or his designee) will contact the laboratory daily to provide information about impending shipments.

4.5.3 Laboratory Sample Custody

The EA field team leader will notify the laboratory of upcoming field sampling activities and subsequent sample transfer to the laboratory. This notification will include information concerning the number and type of samples to be shipped, as well as the anticipated sample arrival date.

The laboratory will designate a sample custodian who will be responsible for maintaining sample custody and for maintaining all associated custodial documentation records. After receiving the samples, the sample custodian will check the original chain-of-custody record and request for analysis documents against the labeled contents of each sample container for correctness and traceability. The sample custodian will then sign the chain-of-custody record and record the date and time that the sample shipment was received at the laboratory. The samples will then be logged into the laboratory system.

Care will be exercised in the laboratory to annotate any labeling or descriptive errors associated with the sample containers. In the event of discrepant documentation, the laboratory will immediately contact the EA field team leader or CTO Manager as part of the corrective action process. A qualitative assessment of each sample container will be performed to note any anomalies such as broken or leaking bottles. This assessment will be recorded as part of the incoming chain-of-custody procedure.

Samples will be stored in a secured area and at a temperature of approximately 4°C, if necessary, until analyses are performed. A laboratory chain-of-custody record will accompany the sample or sample fraction through final analysis for sample control. A copy of the chain-of-custody record will accompany the laboratory's analytical report and will become a permanent part of the project's records. The pH of incoming water samples will be checked by the laboratory when preservatives have been added to the sample. Details of the chain-of-custody for laboratory activities will be provided in the laboratory's QA manual.

4.5.4 Project File

The EA CTO Manager will serve as file custodian. At the project's completion, the files will be returned to the Navy's Northern Division Office where they will be permanently archived.

The project file will contain all incoming materials related to the project such as: sketches, correspondence, authorizations, and logs. These documents will be placed in the project file as soon as possible. If correspondence is needed for reference by project personnel, a copy will be made rather than manipulating the original. Records shall be legible and easily identifiable.

Examples of the types of records that will be maintained in the project file are:

- Field documents.
- Correspondence.
- Photographs.
- Laboratory data.
- Reports.
- Procurement agreements.

Outgoing project correspondence and reports will be reviewed by the project manager or designee prior to mailing.

To prevent the inadvertent use of obsolete or superseded project-related procedures, all personnel of the laboratory and project staffs will be responsible for reporting changes in protocol in writing to the Project Manager and the Laboratory Director. The Project Manager and Laboratory Director will then inform the project and laboratory staffs and the Quality Assurance Officer of these changes, as appropriate.

Revisions to procedures shall be subject to the same level of review and approval as the original document. Outdated procedures shall be marked "void." The voided document may be destroyed at the request of the Project Manager; however, it is recommended that one copy of the voided document be maintained in the project file. The date and reason why the document was voided will be recorded.

4.6 CALIBRATION PROCEDURES AND FREQUENCY

Instruments and equipment used to gather, generate, or measure environmental data will be calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of results are consistent with the instrument manufacturer's specifications.

Laboratory instrumentation calibration procedures and frequencies are specified in the Contract Laboratory Program (CLP) Statement of Work (SOW), for Organic Analysis; Multi-Media, Multi-Concentration; SOW No. 3/90; revised July 1991 and in the CLP SOW for Inorganic Analysis; Multi-Media, Multi-Concentration; SOW No. 3/90; September 1991, and will be strictly followed for those analytes analyzed by CLP protocols. For all other analyses for which EPA-approved methods exist, the laboratory will employ such methods and follow the specified calibration procedures and frequencies. The laboratory quality control program includes strict adherence to routine calibration procedures. A description of calibration procedures and frequencies for non-CLP methods will be provided by the laboratory selected for this program.

Analysis of blank samples, duplicate samples, spiked blanks, and matrix blanks will be performed where possible to document the effectiveness of calibration procedures. Method blanks contain all the reagents used in the preparation and analysis of the samples and are processed through the entire analytical scheme to assess spurious contamination from reagents, glassware and other materials used during analysis. The terms method blank and laboratory blank are interchangeable. A matrix blank denotes a blank of a similar matrix (e.g., for liquids a blank of distilled-deionized reagent grade high purity water may be used; for soils/sediments high purity sand may be used). A spike blank is a method blank which has had a known concentration of a particular compound or analyte added to it to assure adequate percent recovery of the compound/analyte.

Records of calibration, repair, or replacement will be maintained by the designated laboratory personnel performing quality control activities. Calibration records of assigned laboratories will be filed and maintained at the laboratory location where the work is performed and subject to QA audit.

Calibration of field instruments will be performed and documented at approved intervals as specified by the manufacturer or more frequently, as conditions dictate. At a minimum all field instruments will be calibrated at the beginning and end of each day. Calibrations may also be performed at the start and completion of each test run; however, such calibrations will be re-initiated as a result of delay due to meals, work shift change, or instrument damage. Calibration standards used as reference standards will be traceable to the National Institute of Standards and Technology (NIST), when possible. Calibration procedures for field instruments will be as specified by the instrument manufacturer. Equipment manuals describing calibration procedures will be maintained in the field office during site investigations.

4.7 ANALYTICAL PROCEDURES

4.7.1 Introduction

EPA-approved methods will be used for all analyses for which such methods exist. TCL and TAL parameters will be analyzed by CLP protocols. The laboratory will follow methods detailed in the CLP Statement of Work (SOW) for Organic Analyses, Multi-Media, Multi-Concentration, 3/90, revised July 1991, and the SOW for Inorganics Analyses, Multi-Media, Multi-Concentration, 3/90), revised September 1991. If sample contaminant concentrations are high, then CLP protocols for low and medium concentration samples may be required. In this case, sample runs at lower dilutions will be performed to obtain quantitative results for parameters present at lower concentrations.

That is, samples are pre-screened to estimate concentration levels. According to EPA methodology, high concentration samples are diluted to bring them within a linear working range. Low concentration samples are set aside and then analyzed within the same linear working range. It may not be possible to quantitate sample results in parts per billion for samples where "pure" waste (fuel product, paint, powder, etc.) is encountered. A decision tree approach will be followed, in order to quantitate the sample when high levels of contamination are encountered. In this case, detection limits will be raised for all analytes on the sample, as the sample is diluted.

4.7.2 Target Compound List-Organic Compounds

All organic compound analyses will be conducted according to the U.S. EPA CLP, Statement of Work for Organic Analyses, SOW 3/90, revised August 1991. The organic compounds contained in the TCL will be determined using proven instruments and techniques to identify and quantify volatile, semi-volatile and pesticide/PCB compounds. The TCL compounds and CLP-required detection limits are shown in Tables 4-5 through 4-7. The actual detection limits obtainable for a specific sample depend upon matrix interferences. If the CLP detection limit is unachievable for a particular sample, an explanation of the problem and supporting evidence will be provided by the laboratory in the case narrative summary submitted with the deliverables.

Each set of samples will be analyzed in conjunction with the analysis of QC samples, including field duplicates, blanks, matrix spikes and matrix spike duplicate (MS/MSD) samples for quality control determinations. The frequency of analysis of the QC samples, as previously presented in Section 4.4.4, will not be less than one per 20 samples and at least one per sampling day for field blanks, not less than one per 10 samples for field duplicates, and not less than one per 20 samples for MS/MSD samples (see Table 4-2). All samples, field duplicates, blanks, matrix spike and matrix spike duplicates will be fortified with surrogate spiking compounds as shown in Table 4-8. The CLP recommended guidelines for percentage recovery of the surrogate compounds are provided in Table 4-9. The percentage recovery of the matrix spiking compounds and relative percentage difference of duplicate analyses will be calculated to obtain measurements of the analyses accuracy and precision.

4.7.3 Target Analyte List-Metals

All water and soil samples will be prepared for analyses as described by procedures for each respective matrix and analysis method described in the U.S. EPA CLP, Statement of Work for Inorganic Analyses (SOW 3/90). Each set of samples, or 20 samples, whichever is more frequent, will be analyzed with a preparation blank, duplicate sample, and matrix spiked sample. Each group of 20 samples will be analyzed with a laboratory control sample of similar matrix. The Target Analyte List (TAL) for metals and inorganics and associated detection limits are listed in Table 4-10.

The atomic absorption (AA) instrument will be calibrated through the use of a minimum of three calibration standards prepared by dilution of certified stock solutions. Calibration standards will contain acid(s) at the same concentration as the digestates. An analysis blank will then be prepared, and one calibration standard will be at the EPA-CLP required detection limit for the metal being evaluated.

The other standard concentrations will bracket the concentration range of the samples. A continuing calibration standard, prepared from a different stock solution than that used for the calibration standards, will be prepared and analyzed after every ten samples or every two hours of continuous instrument operation. The value of the continuing calibration standard concentration must agree with requirements of the CLP SOW.

4.7.4 Petroleum Hydrocarbons

EPA Method 418.1 will be used for analysis of petroleum hydrocarbons. "Petroleum hydrocarbons" is a measure of the non-biodegradable mineral oils in the sample. The detection limit for a water sample is 2 milligrams per liter (mg/L) and that for soils sediment is 20 micrograms per gram (μg/g).

The method is applicable to water samples and is used in the measurement of light fuels, although loss of approximately half of any gasoline present during extraction manipulations can be expected.

In the procedure, the sample is acidified to a low pH ($<$2) and serially extracted with fluorocarbon-113 in a separatory funnel. Interferences are removed with silica gel adsorbent. Infrared analysis of the extract is performed by direct comparison with standards. Analyses of soil samples will be performed by soxhlet extraction in trichlorotrifluoroethane solvent, followed by treatment with silica gel prior to infrared analysis.

4.7.5 Toxicity Characteristic Leaching Procedure Analysis

Toxicity Characteristic Leaching Procedure (TCLP) extraction and analysis will be conducted using methods described in this QAPP, and procedures outlined in TCLP Method 1311, as presented in 40 CFR Part 261.24, Appendix II.

4.7.6 Dioxin/Furan Analysis

Samples will be collected and/or archived for dioxin/furan analysis according to EPA Modified Method 8280. The samples will be collected in a 250-mL wide-mouth amber jar and stored at 4°C.

4.8 DATA REDUCTION, VALIDATION, AND REPORTING

4.8.1 Introduction

The procedures used for calculations and data reduction are specified in each analytical method referenced in Section 4.7 of this document. Raw data will be entered in bound laboratory notebooks. A separate book will be maintained for each analytical procedure. The data will be entered such that sufficient space remains to enter all subsequent calculations required to arrive at the final (reported) value for each sample.

Calculations include factors such as sample dilution ratios, corrections for titrant normality, and conversion to dry-weight basis for solid samples. Instrument chart recordings and calculator printouts will be labeled and attached to their respective pages, except for voluminous gas chromatograms which will be cross-referenced and stored separately.

Calculations will be checked from the raw data to final value stages prior to reporting the results for a group of samples. Results obtained from extreme ends of standard curves generated by linear regression calculator programs will be checked against graphically-produced standard curves if the correlation coefficient of a program curve is less than 0.995.

Data will generally be reported as micrograms of analyte per liter for aqueous samples or micrograms per kilogram (dry weight) for solid or non-aqueous liquid samples. Concentration units will always be listed on reports and any special conditions, such as dry weight conversions, will be noted. The data reporting form will also include the unique sample number assigned to each sample, details of sample collection including the client's identification number, and the dates of sample receipt and report preparation.

4.8.2 Data Reduction

4.8.2.1 Target Compound List Compounds

Instrument performance test data will accompany the raw data during data reduction. The following criteria must be attained to make a qualitative identification of an organic pollutant using Gas Chromatograph/Mass Spectrometer (GC/MS) techniques:

- Characteristic ions for each compound of interest must maximize in the same or within one scan of each other.
- Retention time must occur within +1 percent of the retention time of the authentic compound.

Relative peak heights of the three characteristic ions in the Extracted Ion Current Profile (EICP) must fall within +20 percent of the relative intensities of these ions in a reference mass spectrum. The reference mass spectrum can be obtained by a standard analyzed in the GC/MS system or from a reference library.

- The entire mass spectrum of the compound of interest is compared to the reference compound.

Structural isomers having similar mass spectra can be explicitly identified only if the resolution between authentic isomers in a standard mix is acceptable. Acceptable resolution is achieved if the baseline-to-valley height between the isomers is less than 25 percent of the sum of the two peak heights. Otherwise, structural isomers are identified as isomeric pairs. When a compound has been identified, the quantitation of that compound is based on the integrated abundance from the EICP of the primary characteristic ion. The base peak ion of internal and surrogate standards is used in the quantitation. If the sample produces an interference for the first listed ion, a secondary ion is used to quantitate. Quantification is performed using internal standard techniques.

To ensure that reported data are accurate, all resultant data are verified. Retention items and area counts are checked carefully for correct identification and accurate quantification.

4.8.2.2 Metals and Cyanide

The concentrations of metals determined by Atomic Absorption Spectroscopy (AAS) measurements are obtained by comparison of absorbance values with those obtained from the analyses of known standards. A linear regression plot of absorbance versus concentration will be used to determine a concentration factor for linearity of response. In the event of low (<85%) or high (>115%) post-digestion spike recovery, the analysis will be repeated using the method of known additions to determine potential matrix interferences.

CLP criteria will be maintained for analyses of samples of similar matrix. The mean percentage recovery and standard deviation will be calculated from a minimum of 20 analyses. A warning limit of +2 standard deviations from the mean and a control limit of +3 standard deviations will be used to establish that the test is providing accurate data.

4.8.3 Data Validation

Data validation is the process of reviewing data and associated quality control criteria and accepting, qualifying, or rejecting it on the basis of sound criteria. Project supervisory and QC personnel will use validation methods and criteria appropriate to the type of data and the purpose of the measurement. Records of all data will be maintained, even that judged to be an "outlying" or anomalous value. The QA/QC Manager validating the data will have sufficient knowledge of the technical work to identify questionable values.

4.8.3.1 Field Data Validation

Field sampling data will be validated by the EA Field QC Coordinator or QA/QC Manager, based on their judgment of the representativeness of the sample, maintenance and cleanliness of sampling equipment, and adherence to the approved, written sample collection procedure. The following criteria will be used to evaluate the field sampling data:

- Use of approved sampling procedures.
- Use of reagents that have conformed to QC-specified criteria.
- Proper chain-of-custody maintained and documented.

4.8.3.2 Analytical Data Validation

Analytical data validation will include validation procedures within the laboratory and independent of the laboratory.

Data from laboratory analyses will be validated by the laboratory QC Coordinator using criteria outlined in the QA Project Plan. Results from field and laboratory method blanks, replicate samples, equipment rinsates and internal QC samples will be used to validate analytical results.

The criteria listed below will be used to evaluate the analytical data:

- Use of approved analytical procedures.
- Use of properly operating and calibrated instrumentation.
- Acceptable results from analyses of laboratory control samples (i.e., the reported values should fall within the 95 percent confidence interval for these samples).
- Precision and accuracy for this project should be comparable to that achieved in previous analytical programs and consistent with objectives stated in Section 4.7 of this QA Project Plan.

Independent of the analytical laboratory, analytical data validation will be conducted which will follow the most stringent of the requirements and protocols specified in the following documents:

U.S. EPA, "Region I Laboratory Data Validation: Functional Guidelines for Evaluating Organic Analyses", February 1988; modified November 1988

U.S. EPA, "Region I Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses", June 1988, modified February 1989

U.S. EPA, Contract Laboratory Program Statement of Work for Organic Analysis, Multi-Media, Multi-Concentration, 3/90, revised August 1991

U.S. EPA, Contract Laboratory Program, Statement of Work for Inorganic Analysis, Multi-Media, Multi-Concentration, 3/90

U.S. Navy/NEESA, Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program (NEESA 20.2-047B), June 1988.

One hundred percent of the Phase III RI data will be validated in accordance with these requirements.

The data validation activities focus on areas of the analytical process which are under the laboratory's control when analyzing samples. The data qualifiers which result from validation represent the QC areas under the laboratory's control which could have been improved. Qualifiers attached to the data during validation supersede the qualifiers assigned by the laboratory.

Areas reviewed in the validation of organic data include the following: sample holding times, gas chromatography/mass spectroscopy (GC/MS) tuning, instrument calibration, blank analysis, surrogate recovery, matrix spike/matrix spike duplicates, internal standards (IS) performance, Target Compound List (TCL) compound identification, compound quantitation and reported detection limits, tentatively identified compounds, system performance, and overall assessment of the data for usability.

The areas reviewed in the validation of inorganic data include the following: sample holding times, instrument calibration and initial calibration verification, continuing calibration verification, Contract Required Detection Limit (CRDL) standards for Atomic Absorption (AA) and Inductively Coupled Plasma (ICP) spectrometers, initial and continuing calibration blank analysis, ICP interference check sample analysis, spiked sample analysis, post digested spike sample recovery analysis, duplicate sample analysis laboratory control sample analysis, ICP serial dilution analysis, graphite furnace AA QC analysis, quarterly verification of instrument parameter report, and sample result verification.

4.8.4 Identification and Treatment of Outliers

Any data point which deviates markedly from others in its set of measurements will be investigated; however, the suspected outlier will be recorded and retained in the data set. The following tests will be used to identify outliers.

Dixon's test for extreme observations is an easily computed procedure for determining whether a single very large or very small value is consistent with the remaining data. The one-tailed t-test for difference may also be used in this case. It should be noted that these tests are designed for testing a single value. If more than one outlier is suspected in the same data set, other statistical methods, such as analysis of variance, tolerance intervals, or control charts, will be considered and the most appropriate method will be used and documented.

Since an outlier may result from unique circumstances at the time of sample analysis or data collection, those persons involved in the analysis and data reduction will be consulted. This may provide information on an experimental reason for the outlier. Further statistical analysis will be performed with and without the outlier to determine its effect on the conclusions. In any cases, two data sets will be reported, one including and one excluding the outlier.

In summary, every effort will be made to include the outlying values in the reported data. If the value is rejected, it will be identified as an outlier, reported with its data set and its omission noted.

4.8.5 Analytical Deliverables

Analytical deliverables will meet the requirements of the U.S. EPA CLP SOW for Organic Analysis; Multi-Media, Multi-Concentration, 3/90, revised July 1991, and the U.S. EPA CLP SOW for Inorganic Analysis, Multi-Media, Multi-Concentration, 3/90, revised September 1991.

4.9 INTERNAL QUALITY CONTROL CHECKS AND FREQUENCY

4.9.1 Introduction

Quality control checks will be performed to ensure the collection of representative samples and the generation of valid analytical results on these samples. These checks will be performed by project participants through the program under the guidance of the EA QA Officer.

4.9.2 Data Collection and Sampling QC Procedures

The EA internal QC checks for the sampling aspects of this program will include, but not be limited to, the following:

- Use of field notebooks to ensure completeness, traceability, and comparability of the samples collected.
- Field checking of field notebooks and sample labels by a second person to ensure accuracy and completeness.
- Strict adherence to the sample chain-of-custody procedures outlined in Section 4.5 of this document.
- Collection and analysis of trip blanks, source blanks, field blanks, and field duplicates.
- Calibration of the field monitoring equipment (HNU and/or OVA), as described in Section 4.6 of this document.

4.9.3 Analytical QC Procedures

4.9.3.1 Trip Blank Analysis

Volatile organic samples are susceptible to contamination by diffusion of organic contaminants through the Teflon-faced silicone rubber septum of the sample vial. Therefore, trip blanks will be analyzed to monitor for possible sample contamination during shipment. Trip blanks will be prepared by filling two volatile vials with laboratory-supplied organic-free water which then will be shipped with the field sampling kit. Trip blanks accompany the sample bottles through collection and shipment to the laboratory and are stored with the samples. Following the analyses, if the trip blanks indicate possible contamination of the samples, depending upon the nature and extent of the contamination, the sample results will be qualified with respect to the contamination detected in the trip blanks. Results of trip blank analyses will be maintained with the corresponding sample analyses data in the project file.

4.9.3.2 Reagent Blank Analysis

A reagent blank is a volume of deionized, distilled laboratory water carried through the entire analytical procedure. The volume of the blank must be approximately equal to the sample volume processed. A reagent blank should be performed with each group of samples. Analysis of the blank verifies that method interferences caused by contaminants in solvents, reagents, glassware, and other sample processing hardware are known and minimized. Optimally, a reagent blank should meet CLP criteria. Results of reagent blank analyses will be maintained with the corresponding analytical data in the project file.

4.9.3.3 Duplicate Sample Analysis

Duplicate analyses are performed to evaluate the precision of an analysis. Results of the duplicate analyses are used to determine the relative percent differences between duplicate samples. Field (blind) duplicate samples will be collected for each media sampled at a frequency of one per ten samples collected. Duplicate analysis results will be summarized on the quality control data summary form.

4.9.3.4 Verification/Reference Standard

On a quarterly basis, the laboratory Quality Control Coordinator introduces a group of prepared verification samples, or standard reference materials, into the analytical testing regime. The laboratory checks and approves the purity of standards and reagents prior to use. Results of the verification/reference standard data will be summarized, evaluated, and presented to laboratory management for review and corrective actions, if appropriate.

4.9.3.5 Other Laboratory Quality Control Checks

Quality control checks will be performed to ensure the collection of representative samples and the generation of valid analytical results on these samples. These checks are performed by project participants under the guidance of QC personnel.

The laboratory will make use of various types of QC samples to document the validity of the generated data. The following types of QC samples are routinely used:

- Calibration Check Samples—One of the working calibration standards which is periodically used to check that the original calibration is still valid.

- Spiked Samples—Aliquots of project samples are spiked with components of interest and carried through the entire preparative and analytical scheme.

- Laboratory Control Samples (LCS)—These samples are prepared from EPA Environmental Monitoring Systems Laboratory (EMSL) concentrates or National Bureau of Standards (NBS) standard reference materials. The LCS are used to establish that an instrument or procedure is in control. An LCS is normally carried through the entire sample preparation and analysis procedure.

- Surrogate Spikes—Requiring analysis by GC/MS are routinely surrogate-spiked with a series of deuterated analogues of the components of interest. It is anticipated that these compounds would assess the behavior of actual components in individual program samples during the entire preparation and analysis scheme.

- Matrix Spikes/Matrix Spike Duplicates (MS/MSD)—One MS/MSD pair will be run per 20 samples for each different matrix analyzed. These pairs will be spiked with the target compounds of concern for that matrix.

All values which fall outside the QC limits described in the analytical method will be noted. The following analytical guidelines will be used to check recovery values which fall outside the QC limits:

1. All recovery data are evaluated to determine if the QC limits are appropriate and if a problem may exist even though the limits are being achieved (e.g., one compound that is consistently barely within the lower limit).

2. All recovery data which are outside the established limits are evaluated. This evaluation includes an independent check of the calculation.

3. Corrective action is performed if any of the following are observed:

   — All recovery values in any one analysis are outside the established limits.

   — Over 50 percent of the values for a given sample set are outside limits.

   — One compound is outside the limits in over 50 percent of the samples.

Reagents used in the laboratory are normally of analytical reagent grade or higher purity. Each lot of acid or solvent used is checked for acceptability prior to laboratory use. All reagents are labeled with the date received and date opened. All glassware is precleaned according to specifications contained in the analytical method.

Standard laboratory practices for laboratory cleanliness, personnel training, and other general procedures are used. A summary of all laboratory quality control analyses and the corresponding control determination is presented in Table 11.

4.9.3.6 Laboratory Control Charts

The control chart displays data in a format which graphically compares the variability of all test results with the average or expected variability of small groups of data. The variability may be due to random (indeterminate) or assignable (determinate) causes. The control chart distinguishes indeterminate from determinate variation in a process or method by its control limits. If a value falls outside the control limits, it is considered out-of-control, almost certainly due to a determinate cause which has been added to the indeterminate variations. The control chart signals the need to investigate, find the determinate cause, and correct it. Construction of a control chart requires a minimum of 14 to 20 duplicate sets of data points (which limits its use).

QC samples and instrument calibrations lend themselves most readily to the gathering of the data. Calculation of control limits and the values are usually plotted chronologically so that trends or cycles can be readily detected. If QC sample measurements show an out-of-control condition, it can be expected that subsequent sample analyses might yield invalid data. The control chart is an effective indicator of the need for corrective action. For volatile and semi-volatile organics and pesticide analyses performed by GC/MS, surrogate recoveries from the method blank are the control sample. For other organics (e.g., PCBs, dioxins/furans), an LCS (spiked blank) is used to plot the control charts. An LCS is also used as the control point for inorganic analyses.

4.10 PREVENTIVE MAINTENANCE

4.10.1 Preventive Maintenance Procedures

Field equipment, instruments, tools, gauges, and other items requiring preventive maintenance will be serviced in accordance with the manufacturer's specified recommendations and written procedure developed by the operators. The laboratory will follow an orderly program of positive actions to prevent the failure of laboratory equipment or instruments during use. This preventive maintenance and careful calibration helps to assure accurate measurements from instrumentation. Routine maintenance procedures are followed for all instruments, glassware, reagents, analytical balances, and equipment used to produce deionized water. Specific procedures will be outlined in the laboratory Standard Operating Procedures (SOPs).

4.10.2 Schedules

Manufacturer's procedures identify the schedule for servicing critical items in order to minimize the downtime of the measurement system. It will be the responsibility of the operator to adhere to this maintenance schedule and to arrange any necessary and prompt service as required. Service to the equipment, instruments, tools, gauges, etc., shall be performed by qualified personnel.

In the absence of any manufacturer's recommended maintenance criteria, a maintenance procedure will be developed by the operator based upon experience and previous use of the equipment.

4.10.3 Records

Logs are maintained to record maintenance and service procedures and schedules. All maintenance records will be documented and traceable to the specific equipment, instruments, tools and gauges. Records produced shall be reviewed, maintained, and filed by the operators at the laboratories and by the data and sample control personnel when and if equipment, instruments, tools and gauges are used at the sites. The project QA officer may audit these records to verify complete adherence to these procedures.

4.10.4 Spare Parts

Critical spare parts are maintained by EA and the laboratory for field and analytical equipment, respectively. These spare parts will be stored for availability and used in order to reduce equipment downtime.

4.11 SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS

4.11.1 Introduction

Procedures used to assess data precision and accuracy will be in accordance with 44 FR 69533 "Guidelines Establishing Test Procedures for the Analyses of Pollutants," Appendix III Example Quality Assurance and Quality Control Procedures for Organic Priority Pollutants", 3 December 1979. Completeness is recorded by comparing the number of parameters initially analyzed with the number of parameters successfully completed and validated. For this project, a target control limit of greater than 90 percent will be used.

4.11.2 Accuracy

The percent recovery is calculated as:

$$\% = \frac{S_s - S_o}{S} x \ 100$$

where

So =The background value, i.e., the value obtained by analyzing the sample.
S =Concentration of the spike added to the sample.
Ss =Value obtained by analyzing the sample with the spike added.
% =Percent recovery.

4.11.3 Precision

The relative percent difference is calculated as:

$$1/2 \ x \ \frac{V_1 - V_2}{(V_1 + V_2)} \ x \ 100 = \% \ difference$$

where:

V1,V2 =The two values obtained by analyzing the duplicate samples.

4.11.4 Completeness

Completeness will be reported as the percentage of all measurements made whose results are judged to be valid. The procedures to be used for validating data and determination of outliers are contained in Section 4.8 of this QAPP. The following formula will be used to estimate completeness:

$$C = 100 \frac{V}{T}$$ where:

C = Percent completeness.
V = Number of measurements judged valid.
T = Total number of measurements.

4.12 CORRECTIVE ACTION

4.12.1 Introduction

The acceptance limits for the sampling and analyses under this program will be those stated in the method or defined by other means in the QAPP. Corrective actions are often immediate in nature, implemented by the analyst or CTO Manager. The corrective action usually involves recalculation, reanalysis, or repeating sample collection.

4.12.2 Immediate Corrective Action

If an immediate corrective action can be taken as part of normal operating procedures, the collection of poor quality data can be avoided. Instrument and equipment malfunctions are amenable to this type of action. QC procedures include troubleshooting guides and corrective action suggestions. The actions taken will be noted in field or laboratory notebooks, but no other formal documentation is required, unless further corrective action is necessary. These on-the-spot corrective actions are an everyday part of the QA/QC system.

Corrective action during the field sampling portion of a program is most often a result of equipment failure or an operator oversight and may require repeating a sampling run. Operator oversight is best avoided by having field crew members audit each others' work before and after a test. Every effort will be made by the field team leader to ensure that all QC procedures are followed. If potential problems are not solved as an immediate corrective action, EA will apply formalized long-term corrective action if necessary.

Corrective action for analytical work will include recalibration of instruments, reanalysis of known QC samples and, if necessary, reanalysis of actual field samples. Specific QC procedures and checklists are used by the laboratory to help analysts detect the need for corrective action. Often the person's experience will be valuable in alerting the operator to suspicious data or malfunctioning equipment.

4.12.3 Long-Term Corrective Action

The need for long-term corrective action may be identified by standard QC procedures, control charts, performance or system audits. Any quality problem which cannot be solved by immediate corrective action falls into the long-term category. The EA QA system ensures that the quality problem is reported to a person responsible for correcting it, and who is part of a closed-loop action and follow-up plan.

The essential steps in the closed-loop corrective action system are listed below:

- Identify and define the problem.
- Assign responsibility for investigating the problem.
- Investigate and determine the cause of the problem.
- Determine a corrective action to eliminate the problem.
- Assign and accept responsibility for implementing the corrective action.

- Establish effectiveness of the corrective action and implement it.
- Verify that the corrective action has eliminated the problem.

Documentation of the problem is important to the system. A Corrective Action Request Form (Figure 4-1) is filled out by the person finding the quality problem. This form identifies the problem, possible causes, and the person responsible for action on the problem. The responsible person may be an analyst, field team leader, QC coordinator, or the QA Officer. If no person is identified as responsible for action, the QA Officer investigates the situation and determines who is responsible in each case.

The Corrective Action Request Form includes a description of the corrective action planned and the date it was taken, and space for follow-up. The QA Officer checks to be sure that initial action has been taken and appears effective and, at an appropriate later date, checks again to see if the problem has been fully solved. The QA Officer receives a copy of all Corrective Action Forms and enters them in the Corrective Action Log. This permanent record aids the QA Officer in follow-up and makes any quality problems visible to management. The log may also prove valuable in listing a similar problem and its solution.

4.12.4 Out-Of-Control Events and Corrective Action

Procedures are outlined as to what corrective action is taken if an out-of-control event occurs, and how it is documented and used to improve laboratory performance. Procedures for assuring that results for samples processed during out-of-control conditions are not reported are also outlined, as well as the conditions necessary to reestablish control and criteria for assuring the system is operating properly. The documentation is easily used by all personnel and is part of routine laboratory procedure.

It is recognized that several levels of out-of-control events may occur. Three examples are given below with corrective actions to be taken:

1. Observations Corrected by Analyst at the Bench—The calibration of an instrument is not linear. The analyst finds this and corrects it prior to continuing to analyze samples. The laboratory documents this event and notes that the corrective action was to recalibrate, and that no samples were affected as none were analyzed prior to calibration.

2. Corrective Actions taken by Supervisor—A matrix spike recovery is out-of- control and the laboratory supervisor finds this after the samples for the day have been analyzed. The supervisor documents that the laboratory blank spiked with surrogates or standards was in control and that other sample spikes were in control, therefore, no re-analysis of the sample is required.

3. Corrective Actions at the Receiving Level—The sample container is broken. The analyst notes this and documents whether or not more samples are available. If no more sample are available, EA is notified and the decision documented.

4.13 QUALITY ASSURANCE REPORTS TO MANAGEMENT

4.13.1 Internal EA Reports

The Project QC Coordinator will provide monthly reports of QC activities for the EA QA Officer and QA/QC Manager. These reports detail the results of quality control analysis, problems encountered, and any corrective action required.

All Corrective Action Forms will be submitted to the EA QA Officer for initial approval of the corrective action planned. A copy will be provided to the appropriate technical division manager. All system audit reports will be provided to the CTO Manager, Division Manager, and Corporate President.

4.13.2 Laboratory Reports

The laboratory QC Coordinator prepares written quarterly reports on QC activities for the laboratory Technical Director and QA Manager. These reports detail the results of QA procedures, problems encountered, and any corrective action which may have been required. All Corrective Action forms are submitted to the QA Manager for initial approval of the planned corrective action, and a copy is provided to the Technical Director. All system audit reports are provided to the Technical Director.

Each data transmittal contains a summary of QA/QC activities; this summary will include:

- Estimates of precision, accuracy and completeness of data.
- Reports of performance and system audits.
- Quality problems found.
- Corrective actions taken.

The final data report to EA will include a summary of QA/QC activities during the project. The QC Coordinator and QA Manager will participate in preparing this report. The summary of QA/QC results for the analytical work conducted for NCBC-Davisville will be included in the final RI Report.

4.13.3 Reports to the U.S. Navy Northern Division

The status of ongoing QA/QC activity will be presented in the project progress reports. Monthly progress reports from the laboratory performing the sample analyses will be sent to the Navy's engineer-in-charge and NEESA QA/QC contract representative, as required. The final RI report for the project will include a section summarizing the significant findings of all QA/QC activity.

FIGURE 4-1

CORRECTIVE ACTION REQUEST FORM

CORRECTIVE ACTION REQUEST FOR NO.___________

Originator________________________________ Date_____________________

Person Responsible
for Replying______________________________ Contract Involved______________

Description of problem and when identified: ______________________________

____

____

____

State cause of problem, if known or suspected: ____________________________

____

____

Sequence of Corrective Action: (If no responsible person is identified, notify QA Officer immediately. Submit all CA forms to QA Officer for initial approval of CA.)

State Date, Person, and Action Planned: _________________________________

____

____

____

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____

____

CA Initially Approved by: ________________________ Date:____________

Follow-up Dates: ____

Final CA Approval by: __________________________ Date:____________

Information copies to:

Responsible Person/QC Coordinator:_________________________________

QA Officer:____

Project Manager:____

TABLE 4-1

CONTAINERS AND PRESENVATION METHODS FOR SOIL, SEDIMENT, AND/OR WASTE SAMPLES

Number Containers per Sample [(a)]	Sample Container	Preservation Methods [(b)]	Analytical Method	Compound(s)
Organics				
2	125 ml. wide-mouth glass, Teflon®-lined cap	Cool, 4°C	CLP SOW	TCL VOA
1	1-250 ml, wide-mouth glass, Teflon® cap	Cool, 4°C	CLP SOW	TCL-BNA, P/P
1	250-ml amber wide-mouth glass, Teflon®-lined cap	Cool, 4°C	8280	Dioxins/ Furans
1	125-ml, wide-mouth glass, Teflon®-lined cap	Cool, 4°C	418.1 [(c)]	Total Petroleum Hydrocarbons
Inorganics				
1	250-ml, wide-mouth glass, Teflon®-lined cap	Cool, 4°C	CLP SOW [(d)]	Metals and Cyanide

VOA = Volatile Organic Analyses.
TCL = Target Compount List.
BNA = Base Neutral and Acid Extractable Analyses.
P/P = Pesticide/PCB Analyses.
CLP SOW = Contract Laboratory Program - Statement of work.
Organics - SOW 3/90, revised July 1991.
Inorganics - SOW 3/90, revised September 1991.

(a) One in 20 organic soil samples will be collected in triplicate for matrix spike and matrix spike duplicate analyses in accordance with CLP protocols and one in 20 inorganic soil samples will be collected in duplicate for matrix spike analyses.

(b) All samples will be stored in a refrigerated, dark area.

(c) Water method is modified for soild analyses, as described in Section 7.0.

(d) Metals analyses, except mercury, will be performed by the furnace atomic absorption (As, Pb, Se, T1) and inductively coupled plasma (ICP) atomic emission spectrometric methods. Mercury will be analyzed by the manual cold vapor atomic absorption method. Total cyanide will be analyzed by the manual spectrophotometric method.

TABLE 4-2
CONTAINERS AND PRESERVATION METHODS FOR AQUEOUS SAMPLES

Number Containers per Sample[a]	Sample Container	Preservation Methods [b]	Analytical Method	Compound(s)
Organics				
2	40 ml, glass, Teflon®-lined cap	Cool, 4°C HC1 (4 drops)	CLP SOW	TCL-VOA
1	1-gal, narrow-mouth amber glass, Teflon®-lined cap	Cool, 4°C	CLP SOW	TCL-BNA, P/P
2	1 L, glass, Teflon®-lined cap	Cool, 4°C HC1 (5 ml)	EPA 418.1	Petroleum Hydrocarbons
Inorganics				
1	500 ml, polyethylene	Cool, 4°C HN_3 to pH<2	CLP SOW [c]	Metals
1	1 L, polyethylene	Cool, 4°C NaOH to pH >12[d]	CLP SOW [c]	Cyanide

TCL = Target Compound List
VOA = Volatile Organic Analyses.
BNA = Base Neutral and Acid Extractable Compounds.
P/P = Pesticides/PCB Analyses.
CLP SOW = Contract Laboratory Program - Statement of Work.
Organics - SOW 3/90, revised August 1991.
Inorganics - SOW 3/90, March 1990.

(a) One in 20 organic aqueous samples will be collected in triplicate for matrix spike and matrix spike duplicate analyses in accordance with CLP protocols; one in 20 inorganic aqueous samples will be collected in duplicate for matrix spike analyses.

(b) All samples will be stored in a refrigerated, dark area.

(c) Metals, analyses, except mercury, will be performed by the furnace atomic absorption (As,Pb, Se, T1) and inductively coupled plasma (ICP) atomic emission spectrometric methods. Mercury will be analyzed by the manual cold vapor atomic absorption method. Total cyanide will be analyzed by the manual spectrophotometric method.

TABLE 4-2

(Continued)

CONTAINERS AND PRESERVATION METHODS FOR AQUEOUS SAMPLES

(d) Water samples to be analyzed for cyanide will be checked in the field for the presence of chlorine using potassium iodide (KI) starch paper. If Chlorine is present, 0.6 g ascorbic acid will be added.

TABLE 4-3

HOLDINGS TIMES FOR SOIL, SEDIMENT, AQUEOUS AND/OR WASTE SAMPLES

	CLP Holding Time for Samples	
Parameter	Aqueous	Soil/Sediment/Waste
TCL Volatile Organic Compounds	10 days from VTSR	10 days from VTSR
TCL Base Neutral/Acid and Extractable Compounds	5 days to extraction from VTSR; 40 days from extraction	7 days (1) extraction from VTSR; 40 days from extraction
TCL Pesticide/PCB Compounds	5 days to extraction; 40 days from extraction	7 days (1) to extraction; 40 days from extraction
Petroleum Hydrocarbons	NA	NA
TAL Metals and Cyanide	6 months; except Hg - 26 days and Cn-12 days	6 months; except HG - 26 days and Cn-12 days
Dioxins/Furans	NA	NA

NA = Not applicable; no holding times established according to the CLP SOW.

VTSR = Verified Time of Sample Receipt.

(1) = U.S. EPA Region I requirement.

TABLE 4-4

FIELD QC SAMPLES PER SAMPLING EVENT (NEESA GUIDANCE FOR LEVEL D)

Type of Sample	Level D	
	Metal	Organic
Trip blank (for volatiles only)	NA[(a)]	1/cooler
Field blank	1/20 samples per matrix or 1/day/matrix for all analytes, whichever is greater	
Source water blank	1/each source water	
Field duplicates [(c)]	10%	10%
Regulatory splits	AN[(b)]	AN[(b)]

a NA - Not Applicable.

b AN - As needed.

c All fields duplicated will be submitted as "blind" duplicates for quality control determinations.

TABLE 4-5

TARGET COMPOUND LIST (TCL)VOLATILE COMPOUNDS AND DETECTION LIMITS

Volatiles	CSA Number	Detection Limits [(a)]	
		Water (ug/L)	Low Soil/Sediment[(b)] (ug/kg)
Chloromethane	74-87-3	10	10
Bromomethane	74-83-9	10	10
Vinyl chloride	75-01-4	10	10
Chloroethane	75-00-3	10	10
Methylene chloride	75-09-2	10	10
Acetone	67-64-1	10	10
Carbon disulfide	75-15-0	10	10
1,1-Dichloroethene	75-35-4	10	10
1,1-Dichloroethane	75-35-3	10	10
1,2-Dichloroethene (total)	156-60-5	10	10
Chloroform	67-66-3	10	10
1,2-Dichloroethane	107-06-2	10	10
2-Butanone	78-93-3	10	10
1,1,1-Trichloroethane	71-55-6	10	10
Carbon tetrachloride	56-23-5	10	10
Bromodichloromethane	75-27-4	10	10
1,2-Dichloropropane	78-87-5	10	10
cis-1,3-Dichloropropene	10061-01-5	10	10
Trichloroethene	79-01-6	10	10
Dibromochloromethane	124-48-1	10	10
1,1,2-Trichloroethane	79-00-5	10	10
Benzene	71-43-2	10	10
trans-1,3-Dichloropropene	10061-02-6	10	10
Bromoform	75-25-2	10	10
4-Methyl-2pentanone	108-10-1	10	10

TABLE 4-5

(Continued)

TARGET COMPOUND LIST (TLC) VOLATILE COMPOUNDS AND DETECTION LIMITS

Volatiles	CAS Number	Detection Limits [(a)] Low Water (ug/L)	Detection Limits [(a)] Low Soil/Sediment[(b)] (ug/kg)
2-Hexanone	591-78-6	10	10
Tetrachloroethene	127-18-4	10	10
Toluene	108-88-3	10	10
1,1,2,2-Tetrachloroethane	79-34-5	10	10
Chlorobenzene	108-90-7	10	10
Ethyl Benzene	100-41-4	10	10
Styrene	100-42-5	10	10
Total Xylenes	1330-20-7	10	10

(a) Detection limits listed for soil/sediment are based on wet weight. The detection limits calculated for soil/sediment calculated on dry weight basis will be higher.

(b) Medium soil/sediment detection limits for volatile TCL compounds are 120 times the individual low soil/sediment detection limits.

Note: Specific detection limits are highly matrix dependent. The detection limits listed herein are provided for guidance and may not always be achievable.

TABLE 4-6

TARGET COMPOUND LIST (TCL) SEMIVOLATILE COMPOUNDS AND DETECTION LIMITS

Semivolatiles	CAS Number	Detection limits [a]	
		Water (ug/1)	Low Soil/Sediment[b] (ug/kg)
Phenol	108-95-2	10	330
Bis(2-chloroethyl)either	111-44-4	10	330
2-Chlorophenol	95-57-8	10	330
1,3-Dichlorobenzene	541-73-1	10	330
1,4-Dichlorobenzene	106-46-7	10	330
1,2-Dichlorobenzene	95-50-1	10	330
2-Methylphenol	95-48-7	10	330
2,2'-oxybis(1-chloropropane)[c]	108-60-1	10	330
4-Methylphenol	106-44-5	10	330
N-Nitroso-di-n-propylamine	621-64-7	10	330
Hexachloroethane	67-72-1	10	330
Nitrobenzene	98-95-3	10	330
Isophorone	78-59-1	10	330
2-Nitrophenol	88-75-5	10	330
2,4-Dimethylphenol	105-67-9	10	330
Bis(2-chloroethos)methane	111-91-1	10	330
2,4-Dichlorophenol	120-83-2	10	330
1,2,4-Trichlorobenzene	120-82-1	10	330
Naphthalene	91-20-3	10	330
4-Chloroaniline	106-47-8	10	330
Hexachlorobutadiene	87-68-3	10	330
4-Chloro-methylphenol (para-chloro-meta-cresol)	59-50-7	10	330
2-Methylnaphthalene	91-57-6	10	330
Hexachlorocyclopentadiene	77-47-4	10	330
2,4,6-Trichlorophenol	88-06-2	10	330
2,4,5-Trichlorophenol	95-95-4	25	800
2-Chloronaphthalene	91-58-7	10	330
2-Nitroaniline	88-74-4	25	800

TABLE 4-6

(Continued)

TARGET COMPOUND LIST (TCL) SEMIVOLATILE COMPOUNDS AND DETECTION LIMITS

Semivolatiles	CAS Number	Detection Limits[a] Water (ug/1)	Low Soil/Sediment[b] (ug/kg)
Dimethylphathalate	131-11-3	10	330
Acenaphthylene	208-96-8	10	330
2,6-Dinitrotoluene	606-20-2	10	330
3-Nitroaniline	99-09-2	25	800
Acenaphthene	83-32-9	10	330
2,4-Dinitrophenol	51-28-5	25	800
4-Nitrophenol	100-02-7	25	800
Dibenzofuran	132-64-9	10	330
2,4-Dinitrotoluene	121-14-2	10	330
Diethylphthalate	84-66-2	10	330
4-Chlorophenyl-phenylether	7005-72-3	10	330
Fluorene	86-73-7	10	330
4-Nitroaniline	100-01-6	25	800
4,6-Dinitro-2-methylphenol	534-52-1	25	800
N-nitrosodiphenylamine	86-30-6	10	330
4-Bromophenyl-phenylether	101-55-3	10	330
Hexachlorobenzene	118-74-1	10	330
Pentachlorophenol	87-86-5	25	800
Phenanthrene	85-01-8	10	330
Anthracene	120-12-7	10	330
Carbazole	86-74-8	10	330
Di-n-butyphthalate	84-74-2	10	330
Fluoranthene	206-44-0	10	330
Pyrene	129-00-0	10	330
Butylbenzylphthalate	85-68-7	10	330
3,3'-Dichlorobenzidine	91-94-1	10	330
Benzo(a)anthracene	56-55-3	10	330
Chrysene	218-01-9	10	330
Bis(2-ethylehexy)phthalate	117-81-7	10	330
Di-n-octylphthalate	117-84-0	10	330

TABLE 4-6

(Continued)

TARGET COMPOUND LIST (TCL) SEMIVOLATILE COMPOUNDS AND DETECTION LIMITS

Semivolatiles	CSA Number	Detection Limits [a]	
		Water (ug/1)	Low Soil/Sediment[b] (ug/kg)
Benzo(b)fluoranthene	205-99-2	10	330
Benzo(k)fluoranthene	207-08-9	10	330
Benzo(a)pyrene	50-32-8	10	330
Indeno(1,2,3-cd)pyrene	193-39-5	10	330
Dibenzo(a,h)anthracene	53-70-3	10	330
Benzo(g,h,i)perylene	191-24-2	10	330

(a) Detection limits listed for soil/sediment are based on wet weight. The detection limits calculated for soil/sediment calculated on dry weight basis will be higher.

(b) Medium soil/sediment detection limits for semivolatile TCL compounds with a low detection limit of 330 ug/kg are 10,000 ug/kg; for semivolatiles with a low detection limit of 800 ug/kg, they are 25,000 ug/kg.

(c) Previously known by the name bis(2-chloroisopropyl)ether.

Note: Specific detection limits are highly matrix dependent. The detection limits listed herein are provided for guidance and may not always be achievable.

TABLE 4-7

TARGET COMPOUND LIST (TCL) PESTICIDES, PCBs, AND DETECTION LIMITS

Pesticides/PCBs	CAS Number	Detection Limits [a] Water (ug/L)	Detection Limits [a] Soil/Sediment[b] (ug/kg)
alpha-BHC	319-84-6	0.05	1.7
beta-BHC	319-85-7	0.05	1.7
delta-BHC	319-86-8	0.05	1.7
gamma-BHA (Lindane)	58-89-9	0.05	1.7
Heptachlor	76-44-8	0.05	1.7
Aldrin	309-00-2	0.05	1.7
Heptachlor epoxide	1024-57-3	0.05	1.7
Endosulfan I	959-98-8	0.05	1.7
Dieldrin	60-57-1	0.10	3.3
4,4'-DDE	72-55-9	0.10	3.3
Endrin	72-20-8	0.10	3.3
Endosulfan II	33213-65-9	0.10	3.3
4,4'-DDD	72-54-8	0.10	3.3
Endosulfan sulfate	1031-07-8	0.10	3.3
4,4'-DDT	50-29-3	0.10	3.3
Methoxychlor	72-43-5	0.50	17.0
Endrin ketone	53494-70-5	0.10	3.3
Endrin aldehyde	7421-93-4	0.10	3.3
alpha-Chlordane	5103-71-9	0.05	1.7
gamma-Chlordane	5103-74-2	0.05	1.7
Toxaphene	8001-35-2	5.0	170.0
AROCLOR-1016	12674-11-2	1.0	33.0
AROCLOR-1221	11104-28-2	2.0	67.0
AROCLOR-1232	11141-16-5	1.0	33.0
AROCLOR-1242	53469-21-9	1.0	33.0
AROCLOR-1248	12672-29-6	1.0	33.0
AROCLOR-1254	11097-69-1	1.0	33.0
AROCLOR-1260	11096-82-5	1.0	33.0

[a] Detection limits listed for soil/sediment are based on wet weight. The detection limits calculated for soil/sediment calculated on dry weight basis will be higher.

TABLE 4-7

(Continued)

TARGET COMPOUND LIST (TCL) PESTICIDES, PCBs, AND DETECTION LIMITS

(b) There is no differentiation between the preparation of low and medium soil samples in this method for the analysis of pesticides/aroclors.

Note: Specific detection limits are highly matrix dependent. The detection limits listed herein are provided for guidance and may not always be achievable.

TABLE 8

SURROGATE SPIKE RECOVERY RANGE

Fraction	Surrogate Compounds	Water % Recovery	Soil/Sediment % Recovery
Volatiles	Toluene-d_8	88-110	84-138
	Bromofluorobenzene	86-115	59-113
	1,2-Dichloroethane-d_4	76-114	70-121
Semi-Volatiles	Nitrobenzene-d_5	35-114	23-120
	2-Fluorobiphenyl	43-116	30-115
	Terphenyl-d_{14}	33-141	18-137
	Phenol-d_5	10-110	24-113
	2-Fluorophenol	21-110	25-121
	2,4,6-Tribromophenol	10-123	19-122
	2-Chlorophenol-d_4	33-110	(20-130)[a]
	1,2-Dichlorobenzene-d_4	16-110	(20-130)[a]
Pesticides	Tetrachloro-m-xylene	(60-150)[a]	(60-150)[a]
	Decachlorobiphenyl	(60-150)[a]	(60-150)[a]

[a] Advisory limits only

TABLE 4-9

MATRIX SPIKE RECOVERY LIMITS

Fraction	Matrix Spike Compound	Water[a]	Soil Sediment[a]
VOA	1,1-Dichloroethene	61-145	59-172
VOA	Trichloroethene	71-120	62-137
VOA	Chlorobenzene	75-130	60-133
VOA	Toluene	76-125	59-139
VOA	Benzene	76-127	66-142
BN	1,2,4-Trichlorobenzene	39-98	38-107
BN	Acenaphthene	46-118	31-137
BN	2,4-Dinitrotoluene	24-96	28-89
BN	Pyrene	26-127	35-142
BN	N-Nitroso-di-n-propylamine	41-116	41-126
BN	1,4-Dichlorobenzene	36-97	28-104
Acid	Pentachlorophenol	9-103	17-109
Acid	Phenol	12-110	26-90
Acid	2-Chlorophenol	27-123	25-102
Acid	4-Chloro-3-Methylphenol	23-97	26-103
Acid	4-Nitrophenol	10-80	11-114
Pesticide	gamma-BHC (Lindane)	56-123	46-127
Pesticide	Heptachlor	40-131	35-130
Pesticide	Aldrin	40-120	34-132
Pesticide	Dieldrin	52-126	31-134
Pesticide	Endrin	56-121	42-139
Pesticide	4,4'-DDT	38-127	23-134

(a) These limits are for <u>advisory purposes only</u>. They are not to be used to determine if a sample should be reanalyzed. When sufficient multi-laboratory data are available, standard limits will be calc

TABLE 4-10

TARGET ANALYTE LIST (TAL) INORGANICS AND CONTRACT REQUIRED DETECTION LIMITS (CRDL) [(a)]

Element	Detection Limit	
	Water (ug/l)	Low Soil/Sediment (ug/g)
Aluminum	200	40
Antimony	60	12
Arsenic	10	2
Barium	200	40
Beryllium	5	1
Cadmium	1.5[c]	1
Calcium	5,000	1,000
Chromium	10	2
Cobalt	50	10
Copper	12[d]	5
Iron	100	20
Lead	3	1
Magnesium	5.000	1,000
Manganese	15	3
Mercury	0.05[c]	0.1[b]
Nickel	40	8
Potassium	5,000	1,000
Selenium	5	1
Silver	1[c]	2
Sodium	5,000	1,000
Thallium	10	2
Vanadium	50	10
Zinc	20	4
Cyanide	10	1

(a) Specific detection limits are highly matrix dependent. The detection limits listed here in are provided for guidance and may not always be achievable. Soil/sediment CRDLs are based on sample wet weights. Dry weight CRDLs will depend on the moisture content of the individual samples.

b Different aliquot.

TABLE 4-10

(Continued)

TARGET ANALYTE LIST (TAL) INORGANICS AND CONTRACT REQUIRED DETECTION LIMITS (CRDL) [a]

[c] Obtain CRDL by using Graphite Furnace Atomic Absorption (AA).

[d] Obtain CRDL by using Inductively Coupled Plasma (ICP).

[e] Obtain CRDL by using Cold Vapor Atomic Absorption (AA).

TABLE 4-11

LABORATORY COOLED CONTROL ANALYSES

Analysis type	Frequency[(a)]	Control
<u>Organic Analyses</u>		
Blank	1	Surrogate compounds
LCS and/or spiked blank	1	% recovery, analytes of interest
Duplicate	2	RPD
Matrix spike	1	% recovery of target analyte[(s)]
Matrix spike duplicate	1	RPD and % recovery
<u>Inorganic Analyses</u>		
Blank	1	No contamination
LCS and/or spiked blank	1	% recovery, analytes of interest
Duplicate	1	RPD
Matrix spike	1	% recovery of target analyte[(s)]

[(a)] Frequency is based on a batch of 20 samples or less of a similar matrix or whenever samples are extracted, whichever is more frequent.

LCS = Laboratory Control Sample

RPD = Relative Percent Difference

TABLE 4-12

NCBC - DAVISVILLE SUMMARY OF PHASE III RI ANALYSES

Site	Monitoring Well Number/Boring Samples	Ground Water Samples	Field Duplicates Soil/GW	Equipment Blanks Soil/GW	Trip Blanks Soil/GW
SITE 03 - CED Solvent Disposal Area	4/8 TCL VOC	4 TCL VOC	1/1	4/1	4/1
SITE 09 - Allen Harbor Landfill	5/10 TCL VOC	7 TCL VOC	1/1	4/1	4/1

Note: 1) One water source sample will be collected for both Sites and analyzed for TCL VOC.

5.0 DATA EVALUATION AND ASSESSMENT PLAN

5.1 INTRODUCTION

Data evaluation and assessment describes the process of characterizing the site on the basis of background investigations, site observations, and field investigations. The objectives of data evaluation and assessment is to define the nature and extent of VOC, identify and evaluate potential chemical transport mechanisms and the environmental fate of identified contaminants.

At Site 09, the objectives also includes defining ecological impacts of the landfill on Allen Harbor, including the discharge of potentially VOC-impacted ground water into Allen Harbor, and on the wetlands to the north and south of the landfill.

Data management and reporting activities are key to conducting the site characterization activities.

5.2 REMEDIAL INVESTIGATION REPORT

The preparation of the Remedial Investigation Report involves the evaluation of analytical data with respect to existing site conditions (e.g., geology, hydrogeology), previous investigation data and background information. This evaluation provides the basis for the determination of the nature and extent of contamination at a given site as well as contaminant fate and transport analyses. The RI Report will present and analyze the Phase I, Phase II, and Phase III RI data.

Initially a draft RI report will be prepared and submitted for review. Upon response to any review comments and approval, the final RI report will be prepared and submitted.

A description of the preparation of the Remedial Investigation Report is provided below. An outline of the report format is presented in Table 5-1.

The individual report sections are described below.

5.2.1 Introduction

The objectives and scope of the Remedial Investigations will be summarized. Background information, including a site description, site history and summary of previous environmental investigations, will be presented.

5.2.2 Site Investigations

The various field investigation methodologies will be described. For each type of field investigation activity, background information pertinent to the site investigations will be briefly summarized. An overview of the investigations will be provided, including the number of samples collected and the analytical methods used for sample analysis. Field observations and measurements, such as soil gas readings, visible contamination, observed odors, etc., will also be provided.

5.2.3 Physical Characteristics

Physical characteristics of the study areas, including physiography, meteorology, surface water hydrology, geology and hydrogeology, will be presented.

5.2.4 Nature and Extent of Contamination

This section presents the results of the site characterization. Initially, contaminant comparison levels will be defined for use in discussing the relative degree of VOC within a given medium. The nature of VOC for each medium sampled at a site will be discussed, based on an evaluation of analytical results. The extent of VOC will be evaluated with respect to sample locations, sample depths and density of sample points. Bedrock contours and ground-water contour maps will be prepared, and used in evaluating nature and extent of VOC.

5.2.5 Contaminant Fate and Transport

This section evaluates identified VOC with respect to their chemical characteristics. Chemical characteristics can be used to predict the fate of VOC within the environment. The persistence of a chemical in a given media will be evaluated and, if determined not to be persistent, potential environmental transport mechanisms and pathways will be identified. This section may be incorporated into the Risk Assessment discussion.

At site 09, fate-transport modeling of VOC in the ground water beneath Allen Harbor will be performed.

<u>Ground-water</u>

The modeling procedure for ground water will consist of developing and calibrating either a two or three layer ground-water flow and transport models. MODFLOW will be the flow model used for this study if the bedrock unit is not considered an aquifer or if the fracture frequency within the bedrock aquifer permits the flow system to be modeled as a porous media. The solute transport model used for the above aquifer system will be RAND3D. If the flow system within the bedrock aquifer can not be adequately simulated as a porous media, the SWIFT/486 model, which can handle both porous media and nonuniform fracture flow, will be used to simulate flow and transport within the aquifer system.

After the flow model has been developed, that is constructed using ground-water levels, hydraulic parameters, fluxes, and boundary conditions, it will be calibrated using both steady-state and transient procedures. Sensitivity analyses (SA) will be preformed prior to calibration to ascertain which parameters impact more significantly on the model.

These parameters will be evaluated more closely than the parameters that have a minimal impact on the model.

The solute transport model will be developed and calibrated utilizing both the estimated loading functions for the selected organic compounds and other constituents and measured concentrations and delineated plumes for these same chemical parameters. The solute transport model will be calibrated by comparing the simulated extent of movement and concentration levels of the selected chemical parameters to their measured equivalents.

The results of the modeling efforts will be to predict exposure point concentrations in Allen Harbor, if they do exist, and to predict the potential movement of the selected constituents within the ground water away from Allen Harbor. A remediation analysis will also be performed where a variety of possible future scenarios will be evaluated. This will include but may not necessarily be limited to the following: pump and treat scenarios; containment scenarios where steel pilings, slurry walls, and RCRA landfill caps may be designed as a unit or designed separately; and combination of the two previous scenarios.

Surface Water

The RMA-2 model will be used to simulate the fate and transport of the constituents of concern in the surface waters of Allen Harbor. RMA-2 is a 2-dimensional, vertically average, finite element hydrodynamic model suitable for calculating the flow field associated with tidal flushing in an embayment. The associated water quality modeling system is contained in the module RMA-4. The model was developed for and is supported by the US Army Corps of Engineers, Waterways Experiment Station, Vicksburg, Mississippi (the TABS modeling system).

In order to apply the model a finite element grid will be constructed for Allen Harbor and the inlet channel from Narragansett Bay. The finite element technique allows variable cell sizes to be used which results in a more accurate representation of the basin geometry. The depth data will be taken from the most recent NOAA chart of the local area (chart number 13223). The model will be driven with a sinusoidal tide curve at the Narragansett Bay boundary.

The mass loading provided by the ground-water model to the bottom sediment of Allen Harbor will be partioned between the sediments and pore water. The resulting dissolved concentrations and ground-water flows to the surface waters of Allen Harbor will be used as a source loading to the model cells in a manner reflecting the spatial distribution present in the groundwater model. The available surface water chemistry data in the vicinity of Allen Harbor will be reviewed to determine an appropriate background concentration for each constituent of interest in Narragansett Bay. These values will be applied at the Narragansett Bay boundary during the flooding portion of the tidal cycle. Constituent decay will be included in the model for appropriate parameters when the decay coefficient is adequately known.

The model will be executed for a sufficient number of tidal cycles for a steady state solution to be achieved. The resulting model output will provide the spatial distribution of surface water concentrations within Allen Harbor as a function of time during the tidal cycle. The results are summarized and presented in a useable format. For evaluations with respect to chronic criteria tidal average concentrations would be appropriate. However, for acute criteria, a presentation of the variability over a tidal cycle may be necessary.

5.2.6 Summary and Conclusions

The RI Report summary and conclusions will provide a summary of the nature and extent of VOC, VOC fate and transport mechanisms and potential risks to human health and the environment posed by the sites. Conclusions will consist of a discussion of data limitations and their impact on the site characterization, recommendations for additional site investigations, if any, and recommended remedial action objectives, which will lead into the Feasibility Study process.

5.3 ECOLOGICAL RISK ASSESSMENT REPORT

A proposed outline of the marine Ecological Risk Assessment Report is shown in Table 5-2.

TABLE 5-1

PROPOSED REPORT FORMAT FOR RI AT NCBC-DAVISVILLE

Executive Summary

1. Introduction
   - 1.1 Objective and Scope
   - 1.2 Site Background
     - 1.2.1 Site Description
     - 1.2.2 Site History
     - 1.2.3 Previous Investigations
   - 1.3 Report Organization

2. Site Investigations
   - 2.1 Subsurface Soil Investigations
   - 2.2 Ground-Water Investigations
   - 2.3 Ecological Investigations

3. Physical Characteristics of each Study Area
   (Includes results of field activities to determine physical characteristics. These may include some, but not necessarily all, of the following):

   - 3.1 Physiography
   - 3.2 Meteorology
   - 3.3 Surface Water Hydrology
   - 3.4 Geology
   - 3.5 Soils
   - 3.6 Hydrogeology
   - 3.7 Demography and Land Use
   - 3.8 Ecology

TABLE 5-1 (Continued)

PROPOSED REPORT FORMAT FOR RI AT NCBC-DAVISVILLE

4. Nature and Extent of Contamination at Each Site
    - 4.1 Subsurface Soils
    - 4.2 Ground-Water

5. Contaminant Fate and Transport at Each Site
    - 5.1 Potential Routes of Migration
    - 5.2 Contaminant Persistence
    - 5.3 Contaminant Migration

6. Summary and Conclusions
    - 6.1 Summary
        - 6.1.1 Nature and Extent of Contamination
        - 6.1.2 Fate and Transport
        - 6.1.3 Risk Assessment
    - 6.2 Conclusions
        - 6.2.1 Data Limitations and Recommendations for Future Work
        - 6.2.2 Recommended Remedial Action Objectives

Appendices

A. Technical memoranda on Field Activities (e.g., boring logs, geotechnical test results, level measurements, tidal influence data, etc.)
B. Analytical Data and QA/QC Evaluation Results
C. Risk Assessment Methods

TABLE 5-2

PROPOSED FORMAT FOR ECO RISK ASSESSMENT REPORT

Executive Summary

1. Introduction

2. Problem Formulation
    - 2.1 Review of existing data (i.e., studies at the site)
    - 2.2 Ecological Site Characterization
    - 2.3 Qualitative evaluation of contaminant release, migration, and fate (including bioaccumulation)
    - 2.4 Identification of contaminants of concern
    - 2.5 Identification of exposure pathways
    - 2.6 Identification of receptors (including endangered species)
    - 2.7 Known ecological effects of the contaminants
    - 2.8 Selection of endpoints for further study
    - 2.9 Conceptual model

3. Exposure Assessment
    - 3.1 Quantification of release, migration, and fate
        - 3.1.1 Direct measurements
        - 3.1.2 Fate and transport models (noted data gap)
        - 3.1.3 Characterization of receptors (based on selected endpoints)
            - 3.1.3.1 Feeding habits
            - 3.1.3.2 Life histories
            - 3.1.3.3 Other attributes affecting exposure
        - 3.1.4 Exposure point concentrations (for selected receptors based on evaluation of release, migration, and fate) including bioaccumulation

4. Effects Assessment
    - 4.1 Dose response information for selected receptors/endpoints
        - 4.1 Literature
        - 4.2 Field Studies (i.e., changes in population structure)
        - 4.3 Toxicity testing

5. Risk Characterization
    - 5.1 Point estimates
    - 5.2 Distributional analysis
    - 5.3 Summary of risks and uncertainties
    - 5.4 Interpretation of ecological significance

SITE SAFETY, HEALTH, AND EMERGENCY RESPONSE PLAN (SHERP)
NAVAL CONSTRUCTION BATTALION CENTER DAVISVILLE, RHODE ISLAND

PHASE III REMEDIAL INVESTIGATION INSTALLATION RESTORATION PROGRAM SITES 03 AND 09

Contract No. N62472-92-D-1296
Contract Task Order No. 0032

Prepared for:

Department of the Navy
Northern Division
Naval Facilities Engineering Command
10 Industrial Highway
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DRAFT
October 1994
EA Project 296.0032

SITE SAFETY, HEALTH, AND EMERGENCY RESPONSE PLAN NAVAL CONSTRUCTION BATTALION CENTER DAVISVILLE, RHODE ISLAND

PHASE III REMEDIAL INVESTIGATION
INSTALLATION RESTORATION PROGRAM
SITES 03 AND 09

Contract No. N62472-92-D-1296
Contract Task Order No. 0032

Kris H. Hoiem, Certified Industrial Hygienist Program Safety and Health Officer	Date
Nicholas A. Lanney CTO Manager	Date

October 1994
EA Project 296.0032

CONTENTS

CONTENTS (Continued)

LIST OF TABLES

LIST OF FIGURES

SITE SAFETY, HEALTH, AND EMERGENCY RESPONSE PLAN

1. SITE INFORMATION

SITE: Naval Construction Battalion Center, Davisville
LOCATION: Installation Restoration Program Site 03, Solvent Disposal Area and Site 09, Allen Harbor Landfill, North Kingstown, Rhode Island
SCHEDULED FIELD ACTIVITIES DATES: December 1994 - January 1995

2. PERSONNEL

2.1 KEY PERSONNEL

CTO Manager:	Nicholas Lanney (617) 784-1767
Program Safety and Health Officer:	Kris Hoiem, CIH (410) 771-4950
Site Manager:	George Lukert (617) 784-1767
Site Safety and Health Officer:	Susan Braun (617) 784-1767
Field Personnel:	K. Caldwell, J. Friesen
Subcontractors:	To Be Assigned

2.2 RESPONSIBILITIES

The responsibilities for safety and health-related issues for Program operations are as follows.

2.2.1 Contract Task Order Manager

The responsibilities of the Contract Task Order (CTO) Manager include:

- Assuring compliance with the Program Safety and Health Management Plan and this Safety, Health, and Emergency Response Plan (SHERP).
- Coordinating with the designated Navy Technical Representative.
- Preparing the SHERP.
- Providing overall supervisory control for safety and health protocols in effect for the project.
- Assigning the Site Manager and Site Safety and Health Officer (SSHO) and assuring that the assigned onsite staff will enforce provisions of the approved SHERP.

- Submitting a letter to the Contracting Officer Technical Representative prior to initiating field work certifying that employees, including subcontractors and consultants, who will work onsite and who may be exposed to hazardous wastes, have completed training, and are currently participating in a medical surveillance program in accordance with OSHA 1910.120, the NIOSH/OSHA/USCG/EPA *Occupational Safety and Health Guidance Manual for Hazardous Waste Activities* and the NEESA *Safety and Health Guidelines for Navy Assessment and Control of Installation Pollutants Confirmation Studies.*

- Assuring adequate resources are available for safety and health.

- Preparing and submitting project reports.

2.2.2 Site Safety and Health Officer

The SSHO will be onsite throughout the project and will be responsible for daily compliance with site safety and health requirements. The duties of the SSHO include:

- Conducting daily inspections of the site.

- Stopping work, and directing evacuation of the work site when imminent safety or health risks exist or as outlined in this SHERP.

- Implementing usage of forms provided in appendixes.

- Implementing the SHERP.

- Conducting regularly scheduled safety and health meetings—typically an agenda item during work progress meetings conducted by the Site Manager. Meetings are conducted daily during intrusive investigations or construction activities, but may be less frequent during non-intrusive investigations.

- Providing an initial safety and health briefing to site workers and visitors.

- Reviewing training and medical records prior to site work.

- Evaluating reported hazardous conditions and recommending corrective action.

- Conducting necessary monitoring.

- Establishing and ensuring compliance with site control areas and procedures.

- Supervising decontamination to ensure decontamination of personnel, tools, and equipment.
- Supervising the distribution, use, maintenance, and disposal of personal protective clothing and equipment.
- Investigating and preparing incident reports as necessary.

2.2.3 Site Manager

The Site Manager (or the Senior Site Supervisor in the absence of the Site Manager) during an emergency will be responsible for initiating and coordinating responses. The Site Manager will:

- Work with the SSHO to identify and evaluate hazards.
- Be responsible for initiating the evacuation of the work site when needed, or as directed by the SSHO, communicating with offsite emergency responders, and coordinating activities of onsite and offsite emergency responders.
- Determine if the abatement of hazardous conditions is sufficient prior to allowing resumption of work operations after an emergency.

2.2.4 Field Personnel and Subcontractors

Employees (including subcontractor and consultant employees) will be responsible for:

- Following this SHERP and applicable safety and health rules, regulations, and procedures.
- Using required controls and safety devices, including personal protective equipment.
- Notifying his/her supervisor of suspected safety or health hazards.
- Complying with training and medical requirements.

2.3 VISITORS

Visitors will be required to read and verify their understanding and willingness to comply with this SHERP (Appendix A). Visitors will remain in an observation area and will not be allowed in the Exclusion Zone unless they have complied with the appropriate Occupational Safety and Health Act (OSHA) training and medical requirements and have the permission of the CTO Manager or the SSHO.

3. PURPOSE AND WORK SCOPE

- To conduct sampling at the Naval Construction Battalion Center (NCBC), IR Program Site 03 and 09, Davisville, Rhode Island, of structures and land areas suspected of being contaminated.
- Sampling will include subsurface soil sampling and ground-water sampling.
- To confirm the presence of contamination and to characterize contamination where it is found on site.

4. SITE DESCRIPTION

4.1 GENERAL DESCRIPTION

Naval Construction Battalion Center (NCBC)-Davisville is located in the northeast section of the Town of North Kingstown, Rhode Island, along Narragansett Bay, 18 mi south of Providence. The site consists of three areas: the Main Center, the West Davisville storage area, and Camp Fogarty (a training facility 4 mi west of NCBC-Davisville). All field activities will take place within zone 3 of the Main Center (Figure 1). Adjacent to NCBC-Davisville's southern boundary is the decommissioned Naval Air Station Quonset Point.

Land at Davisville was originally designated the Advanced Base Depot in 1942, in support of Naval Air Station Quonset Point. Later that year, the Naval Construction Training Center was established to train construction battalions during World War II. The NCBC was inactive after World War II until 1951, when it became the Headquarters Construction Battalion Center. The Construction Battalion Center loaded ships and trained men for both the Korean and Vietnam conflicts. After 1974, operations at Davisville were greatly reduced. In 1989, the closure of Davisville was announced and NCBC-Davisville was directed to close as part of the Defense Authorization Amendments Base Closure and Realignment Act (BRAC II) of 1991.

4.2 AREAS TO BE INVESTIGATED

Areas to be investigated under this contract task order are Installation Restoration (IR) Program Sites 03 and 09. General site descriptions of Sites 03 and 09 are located below in section 4.2.1 and 4.2.2 respectively.

4.2.1 SITE 03, CED SOLVENT DISPOSAL AREA,GENERAL DESCRIPTION

Site 03 is located immediately west of site 02, see Figure 2, in the northwestern portion of NCBC Davisville. It consists of a vacant, flat and previously paved area, bounded by Sayers Street to the east, Parade Street to the north and Battalion Boulevard to the south. The surface of the site is characterized by areas of deteriorated asphalt interspersed with grass. The size of the area is approximately 500 by 1000 feet.

From 1955 to the late 1970's, paint thinners and unidentified solvents were reportedly disposed of on the ground west of Sayers Street and Building 224. While the precise limits of the disposal area are not known, disposal is thought to have occurred in a 1000 by 200 foot area bordering Sayers Street. It is estimated that approximately 3000 gallons of solvents were disposed off on-site. A portion of the site was also use for heavy equipment storage.

In general, overburden deposits at the site consist of native medium sand with variable silt and coarse sand content, with silt and gravel layers. The overburden thickness ranged from 39.3 to 61.5 feet. Competent bedrock was encountered at elevations ranging from 25.5 feet below the mean sea level to 7.2 feet below mean sea level. The bedrock appears to slope downward from the west to east in the western portion of the site and to the north-northwest in the eastern portion of the site. Shallow groundwater flows from the east-northeast while deep groundwater flows generally to the east.

Previous site investigations include and Initial Assessment Study (IAS) by Fred C. Hart Associates, completed in 1984; a Confirmation Study-Verification step, by TRC Environmental Consultants, completed in 1987; Confirmation Study-Characterization Step, completed by TRC in 1988; and a Remedial Investigation completed by TRC in 1991. A Phase II Investigation, completed by TRC in 1992, was done to further delineate horizontal and vertical extent of contamination associated with the solvent disposal area.

In general, surface and subsurface soil and groundwater seem to be minimally impacted by the reported solvent disposal activities. Low levels of pesticides and PCB's were detected in surface soil samples and inorganic were detected in both surface and subsurface soil samples at concentrations exceeding NCBC background ranges. See Table 1A for all soil and ground-water contaminant levels, Table 1B for contaminants which may pose a more significant risk. With the exception of chromium, which exceeds the NCBC background ranges, catch basin sediments were minimally impacted. The presence of low level PCB indicates that the surface soil may be migrating off-site by way of water runoff. Chlorinated solvents were found in the ground-water portion of the overburden aquifer and wells up gradient indicate that the contamination source may be upgradient from site 03.

4.2.2 SITE 09, ALLEN HARBOR LANDFILL, GENERAL DESCRIPTION

Site 09 covers an area of approximately 13.5 acres in the western side of Allen Harbor, see Figure 3. The landfill is bounded to the east and south by Allen Harbor, and to the west by Sanford Road. A marsh in located to the west of the landfill, on the opposite side of Sanford Road, at the edge of the Navy property. Access to the landfill is controlled by a fence and locked gate at the Sanford Road entrance. The landfill is currently overgrown with a mixture of shrubs, small trees, and grasses. The only extensive areas of stressed vegetation appear to be the locations of the former pavement or access roads. Substantial amounts of building debris and rusted metallic objects are visible at various locations across the site. The landfill rises approximately 15-20 feet above the high tide mark along the southeastern perimeter. Throughout the site a variety of construction debris exist, exposed in some areas, including rusty pieces of metal and concrete. Cover materials at the landfill consist of poorly sorted sand and gravel with silt and clay particles. The cover is nonuniform over the landfill varying in depth from one to three feet in thickness.

From 1946 to 1972 Allen's Harbor Landfill was used for waste generated at NCBC Davisville and NAS Quonset Point. A large variety of waste, including large quantities of preservatives, paint thinners, degreasers, PCBs , asbestos, ash, sewerage sludge, 55-gallon drums, and used mineral grit, and contaminated fuel oil were all laid to rest at Allens Harbor Landfill.

Previous site investigations include and Initial Assessment Study (IAS) by Fred C. Hart Associates, completed in 1984; a Confirmation Study-Verification Step, by TRC

Environmental Consultants, completed in 1987; and a Remedial Investigation completed by TRC in 1991.

The Phase II Remedial Investigation was to further delineate the extent of the vertical and horizontal contamination through a series of test and sampling rounds including:

- seismic refractions survey
- electromagnetic conductivity survey
- magnetometry survey
- soil and ground-water samples
- installation of wells and peizometer clusters
- conductivity test

The Phase II RI demonstrated the need for a limited supplemental investigation at the site. Three soil samples and ground-water samples were taken to determine the salinity across the site and to determine the potential for contaminants to leach from the subsurface soil. See Table 1A for all soil and water contaminants levels, Table 1B for contaminants which may pose a more significant risk.

In general the site consists of unconsolidated deposits in three distinct units, refuse/silt, sand/ silt and silt. The refuse/silt lies from 4 to 29 feet in depth near wells MW-08D and -09D while as much as 13 feet of fill was identified below the water table at well MW-06D. The sandy silt layer underling the refuse/silt lense is approximately 1 to 20 feet in thickness interbedded with sandy silt and organic silts and peat. Below the sandy silt layer lies a layer a very soft to very stiff grey silt layer, this layer lies immediately over the bedrock layer and is between 27 and 54 feet in thickness. Bedrock exist at depths ranging from 25 to 81 feet below the ground surface. Bedrock consist of a massive and competent to brittle meta-sandstone gneiss, with shattered schist and shale zones.

5. HAZARD ANALYSIS

5.1 HAZARD COMMUNICATION

The SSHO will conduct regularly scheduled (Section 2.2) safety meetings with all site workers to discuss the planned activities, since these activities and workers may change over the duration of the project.

The SSHO will maintain a current file of complete material safety data sheets (MSDS) (Appendix C) for each hazardous substance stored or used at the work site. Subcontractors must inform the SSHO about hazardous substances that they bring onsite and provide an MSDS. Chemicals brought onsite must be properly labeled in accordance with OSHA's Hazard Communication requirements (29 CFR 1910.1200) and EA's Hazardous Materials Control Program. The file must be easily accessible to employees. Subcontractors and visitors to the work place will be informed of the existence and location of this file.

Workers and visitors will be instructed in how to read and understand the information shown on the MSDS.

Chemicals which may be supplied by EA are: methanol, alconox and non-phosphate detergent (decontamination), and isobutylene (calibration gas). MSDS for these substances can be found in Appendix C of this SHERP.

5.2 CHEMICAL HAZARDS

A list of potential hazardous substances known or suspected to be present at this site are listed in Table 1. The compounds listed in Table 1 were identified through record searches, site visits, and interviews. Please note: if additional file information becomes available which indicates that other chemicals may be encountered during the field activities, Table 1 and this SHERP may need to be revised.

Potential hazardous substances are outlined in Appendix B. The worker exposure limits including Permissible Exposure Limits/Threshold Limit Values (PEL's/TLV's) and the Immediately Dangerous to Life or Health (IDLH) values for these hazardous substances are also included. The expected exposure (e.g. inhalation, dermal contact, and ingestion) to these hazardous substances per field activity is summarized below:

- Soil Sampling - Soil sampling will take place outside. Chemical hazards may involve the exposure to VOCs, PCBs and priority pollutant metals. Possible routes of exposure include inhalation, ingestion and skin absorption.

- Ground-water Sampling - Ground-water sampling will take place outside of buildings and may involve the exposure through inhalation, ingestion, and skin absorption to VOCs, PCBs, TPHs, and priority pollutant metals.

During all phases of the work, strict adherence to the monitoring procedure in Table 2 will help protect against inhalation of organic vapors. The proper personal protective equipment will protect against other types of exposure to the chemical hazards.

5.3 PHYSICAL AND BIOLOGICAL HAZARDS

Physical Hazard Information Sheets, provided in Appendix D, give potential hazards and protective measures. If additional hazards are encountered on the site, they will be added to this SHERP. The following hazard sheets are contained in Appendix D:

- Underground utilities
- Electrical hazards
- Heavy equipment hazards
- Vehicle and pedestrian traffic
- Fire/explosion hazards
- Materials handling/moving/lifting
- Drilling
- Biological hazards
- General physical hazards
- Noise hazards
- Heat stress
- Cold stress

6. EMPLOYEE TRAINING ASSIGNMENTS

Dates of employee training are documented in Table 3. Any person who does not meet these training requirements is prohibited from engaging in site operations. Once the SHERP has been signed by the CTO Manager, no other personnel may be added to the project field work without prior written approval by the CTO Manager or SSHO, who must review the proposed employee's training and medical status. The following training must be completed prior to the start of work operations:

6.1 ALL SITE WORKERS

- Prior to project start-up, 40 hours of initial offsite Hazardous Waste Operations training and 3 days of onsite training under the direct supervision of a more experienced site worker.

- Eight-Hour annual Hazardous Waste Operations refresher training (if >12 months have passed since 40-hour initial training or previous 8-hour refresher).

6.2 SITE MANAGER AND SSHO

- Above requirements for site workers, plus one-time 8-Hour Supervisor's Hazardous Waste Operations Training.

6.3 FIRST AID/CPR

At least two on-site workers must be currently certified in both first aid and CPR by the American Red Cross or equivalent organization. First aid training must be updated every 3 years; CPR training must be updated annually.

6.4 PRE-ENTRY BRIEFING

All site workers will read the SHERP and indicate their understanding of the requirements by signing Appendix A, Site Safety and Health Review Record. The SSHO must check the training status of all onsite personnel and then brief workers on the potential hazards at the site and protective measures to be implemented, both prior to entry and daily during the work. An evacuation location to be used in the event of an emergency must be designated and known to all personnel. This location should be an upwind point from site activities, in an area not expected to be affected by emergency situations onsite. Authorized visitors are not permitted to enter areas where they may be exposed to hazardous substances if they do not meet the training requirements summarized above in Section 6.1

6.5 SUBCONTRACTOR TRAINING

Prior to the start of work operations, the CTO Manager will obtain a written list of subcontractor personnel to be present onsite, and written certification from the subcontractor management that these workers meet the training requirements summarized above in Section 6.1.

Non-hazardous waste site workers will be trained to meet applicable OSHA requirements specific to their work. Training records and certification letters will be managed and maintained per the Program Management Plan.

7. MEDICAL SURVEILLANCE

Hazardous waste site workers must have satisfactorily completed a comprehensive medical examination by a licensed physician within 12 months prior to the start of site operations. Non-hazardous waste site workers will be medically examined to meet OSHA requirements specific to their job. The date of medical examination of each site worker will be recorded on Table 3. Subcontractors will provide this information in writing to the CTO Manager for their workers onsite prior to startup of field activities. Medical surveillance protocols and examination results will be reviewed by a licensed physician who is certified in Occupational Medicine by the American Board of Preventative Medicine. Records will be managed and maintained per the Program Management Manual.

8. PERSONAL PROTECTIVE EQUIPMENT

Based on evaluation of the potential safety and health hazards (Section 5), the required initial levels of personal protective equipment (PPE) are presented in Table 4 for each work task. Upgrade and downgrade PPE levels are listed below:

- **Upgrade PPE Level C**—Components: steel toe/steel shank neoprene safety boots, polycoated tyvek coveralls, latex inner gloves, nitrile or neoprene outer gloves, hard hat, and full face air purifying respirator with organic vapor/HEPA cartridges.

- **Downgrade PPE Level**—None.

Only the SSHO can authorize an upgrade or downgrade in the PPE level worn onsite, using only those criteria presented in Section 9. All changes in PPE levels must be documented on Appendix E, along with the rationale for the PPE changes. When respirators are required, site workers must have been successfully fit-tested within 6 months prior to the start of work operations. Fit-test dates for all site workers are summarized in Table 3.

Subcontractors are required to supply their workers with the appropriate PPE.

The SSHO will review appropriate procedures for donning and doffing PPE prior to the start of work tasks. All PPE must be inspected by site workers prior to use and regularly during use. If any site worker experiences a failure or alteration of PPE that affects the level of protection offered, that person will immediately leave. Re-entry will not be permitted until the equipment has been repaired or replaced.

Hearing protection will be made available and must be worn whenever noise levels exceed 85 dBA (noise level at which a normal conversation cannot be understood at a 3-ft distance). When the SSHO determines that a potential excessive noise exposure exists, a sound level meter or audio dosimetry will be used for measurements. The hearing protectors will have a noise reduction rating sufficient to reduce the sound level to below 85 dBA.

9. ENVIRONMENTAL MONITORING

9.1 ENVIRONMENTAL MONITORING AND ACTION LEVELS

Task-specific environmental monitoring requirements are summarized in Table 2, including the type of monitoring to be performed, the frequency and location of monitoring, action levels, and required responses if action levels are detected. Only personnel trained in proper use and calibration may operate the monitoring instruments.

Where it has been determined that there may be personnel exposure to airborne (particulate) concentrations of hazardous substances, appropriate direct-reading air monitoring and integrated air sampling will be done in accordance with applicable regulations. Visible dust in the breathing zone will require dust suppression or monitoring. If visible dust continues in the breathing zone after suppression is implemented, an upgrade to Level C is required.

Initial and detectable measurements will be logged on the Environmental Monitoring Record, Appendix F. Each exceedence of an action level will also be documented on Attachment F, along with the corrective action taken. If no detectable levels are measured, this will be documented on Attachment F at least once every 30 minutes.

9.2 CALIBRATION OF MONITORING INSTRUMENTS

One calibration procedure sheet is shown in Appendix G for each instrument listed in Table 2. The calibration of each instrument must be performed at the beginning of each day of use and at least once during the day. The calibration of each instrument must be checked according to the manufacturer's recommendations.

10. SITE CONTROL

10.1 WORK ZONES

Work zones have been established as follows:

- **Exclusion** — The Exclusion Zone will be delineated by the SSHO with stakes and hazard tape. All persons entering the Exclusion Zone will wear the appropriate level of PPE for the degree and types of hazards present at the site.

- **Contamination Reduction** — Delineated by the SSHO. All decontamination procedures must take place in the Contamination Reduction Zone. There shall be only one access point between the Exclusion Zone and Contamination Reduction Zone.

- **Support Zone** — Uncontaminated area to include the EA vehicle.

Only authorized personnel will be permitted in the Exclusion and Contamination Reduction zones. Entering these zones will require donning the required PPE prior to entry. Personnel who enter any of the work zones must sign the Site Entry and Exit Log, Appendix H.

10.2 SAFE WORK PRACTICES

Safe work practices to be followed by site workers include:

- Eating, drinking, chewing gum or tobacco, and smoking are prohibited in the Exclusion and Contamination Reduction zones.

- Hands and face must be thoroughly washed upon leaving the work area.

- Prescription drugs must not be taken by personnel unless specifically approved by a licensed occupational physician who is familiar with the issues of worker exposure to hazardous materials.

- When respirators are required, facial hair that interferes with the face-to-facepiece fit of the respirator will not be permitted.

- Contact lenses will not be permitted to be worn in the Exclusion or Contamination Reduction Zones.

- Personnel onsite must use the buddy system; visual contact must be maintained between team members at all times.

- Work is allowed during daylight hours only.

- If dust is being visually generated in the Exclusion Zone, the SSHO will advise on procedures for misting or wetting the soil to prevent possible exposure from inhalation of soil contaminants.

- Possessing, using, purchasing, distributing, selling, or having controlled substances in your system during the work day, including meal or break periods onsite, is strictly prohibited.

- The use of possession of alcoholic beverages onsite is prohibited. Similarly, reporting to work or performing one's job assignments with excessive levels of alcohol in your system will not be permitted.

11. DECONTAMINATION PROCEDURES

11.1 PERSONNEL DECONTAMINATION

Remove and discard boot covers, if worn. Wash boots with detergent and water; rinse. Wash outer gloves with detergent and water, rinse, and remove. Remove disposable coveralls, then respirator, if worn. Remove and discard inner gloves, if worn. Wash hands, face, and other exposed skin with soap and water. Shower and shampoo as soon as possible at the end of the work day, before dining or social activities. Place nondisposable coveralls in plastic bags prior to leaving the site and prior to entering any EA vehicle. Launder nondisposable clothing worn in the Exclusion Zone prior to reuse, separately from other laundry items.

11.2 EQUIPMENT DECONTAMINATION

Instruments used onsite will be wet-wiped with clean water prior to leaving the site. Wet-wipe respirator exteriors whenever exiting work areas. Clean respirators with a manufacturer-recommended sanitizer, then hang to drip dry, and place in plastic bags for protection against dust. Change respirator cartridges at least daily, when breakthrough occurs, or when breathing resistance becomes high, whichever occurs first. Used cartridges shall be damaged to prevent accidental reuse.

Drilling and sampling equipment must be decontaminated in accordance with EPA or state requirements. Discoloration, stains, corrosive effects, and substances adhering to objects may indicate that contaminants have not been removed. Consideration will be given to using wipe tests when conditions warrant.

11.3 VEHICULAR DECONTAMINATION

Vehicles that enter the Exclusion Zone must be decontaminated in the Contaminant Reduction Zone. At a minimum, a thorough detergent and water wash is required. No visible soil will remain on the exterior (including wheels) and the interior will be wet-wiped to remove visible dust and soil.

11.4 WASTE DISPOSAL PROCEDURES

Waste solids generated during work activities (including disposable gloves, respirator cartridges) will be bagged, labeled, and properly disposed. Drill cuttings from boring procedures will be placed in 55-gal drums suitable for hazardous materials. Liquids from decontamination procedures will be collected in a water collection system and stored on the site until analyses and evaluation determines disposal method.

12. EMERGENCY RESPONSE PLAN

12.1 EMERGENCY RECOGNITION

Prior to work start-up, all personnel must be familiar with this Emergency Response Plan. The CTO Manager, Site Manager, or SSHO must make this SHERP available for review and copying by all field personnel. Field personnel will sign the Safety and Health Review Record (Appendix A). Rehearsals of emergency procedures should be performed regularly as part of the ongoing site safety program, and the location of evacuation areas and exit routes should be reviewed. The location of the nearest operating telephone for emergency use should be determined.

Field personnel must immediately stop work, tend to injured personnel, evacuate the Exclusion Zone, and report to the Site Manager any of the following potential emergency situations:

- Medical emergency
- Heavy equipment accident
- Discovery of unanticipated hazards (e.g., drums, heavily contaminated materials, etc.)
- Any chemical release or spill
- Overexposure of personnel to onsite contaminants
- Cold related injury or hypothermia
- Heat related illness.

Onsite emergencies will be handled by offsite emergency support personnel upon their arrival. Initial response and first aid treatment, however, will be available through onsite CPR and first aid certified personnel.

In case of a hazardous materials emergency, the Site Manager or Senior Site Supervisor onsite will take control and direct the emergency response until the arrival of the emergency responders. The Site Manager, Program Safety and Health Officer, or SSHO will work with the emergency responders to identify and evaluate hazards. Emergency responses and communications will be coordinated and controlled through the Onsite Incident Commander, designated by the emergency responders.

12.2 PROCEDURES FOR HANDLING EMERGENCY INCIDENTS

In the event of an emergency, the information available at that time must be properly evaluated and the appropriate steps taken to implement the Emergency Response Plan. The Site Manager (or SSHO if the Site Manager is part of the emergency) shall assume command of the situation. He/she must call the appropriate emergency services, evacuate personnel to the predesignated evacuation location as needed, and take other steps necessary to gain control over the emergency. Emergency telephone numbers, directions to the nearest hospital, and the location of the nearest telephone and other site communication equipment are presented in Appendix I.

Give the following information when reporting an emergency:

1. Name and location of person reporting
2. Location of accident/incident
3. Name and affiliation of injured party
4. Description of injuries, fire, spill, or explosion
5. Status of medical aid and/or other emergency control efforts
6. Details of any chemicals involved
7. Summary of accident, including suspected cause and time it occurred
8. Temporary control measures taken to minimize further risk.

This information is not to be released under any circumstances to parties other than those listed in this section and emergency response team members. Once emergency response agencies have been notified, the CTO Manager, Program Safety and Health Manager, and NAVFAC Technical Manager must be notified immediately.

12.3 MEDICAL EMERGENCIES

Personnel should always be alert for signs and symptoms of illnesses related to chemical, physical, and disease factors onsite. Severe injuries resulting from accidents must be recognized as emergencies and treated as such. At least two employees currently trained in first aid/CPR must be present onsite at all times.

In a medical emergency, the Site Manager (or the SSHO if the Site Manager is not available) must sound the emergency alarm, upon which all work must stop and personnel must move to the decontamination area:

- If the emergency situation cannot be conveyed by word of mouth, an air horn, or other alarm device will be sounded.

- One continuous blast of the air horn will be used as the emergency signal.

- Personnel currently trained in first aid and CPR will evaluate the nature of the injury, decontaminate the victim if the victim can be moved safely, and initiate first aid assistance immediately.

- First aid will be administered only to limit further injury and stabilize the victim.

- The local Emergency Medical Services must be notified immediately if needed.

- Victims that are heavily contaminated with toxic or dangerous materials should be decontaminated before being transported from the site.

- No persons will re-enter the Exclusion Zone until the cause of the injury or symptoms has been determined and controlled.

- A fellow EA worker must accompany injured workers to the hospital to inform the admitting clerk that the injury is work related to assist in completing the insurance forms. A road map to the hospital located nearest to this site is located in Appendix I.

Personnel will not transport victims to emergency medical facilities unless:

- The site is so remote that timely response of medical professionals is not possible.

- The injury does not pose immediate threat to life and transport to the emergency medical facility can be accomplished without the risk of further injury.

The Site Manager must complete an Accident Investigation Report (Appendix J) and submit it to the CTO Manager and Program Manager. The Program Manager will submit the report to the NAVFAC Technical Manager within 24 hours of the following types of incidents:

- Job-related injuries and illnesses.

- Accidents resulting in significant property damage.

- Accidents involving vehicles and/or vessels.

- Accidents in which there may have been no injury or property damage, but which have a high probability of recurring with at least a moderate risk to personnel or property.

- An accident which results in a fatality or the hospitalization of 3 or more employees must be reported within 8 hours to the U.S. Department of Labor via the EA Human Resources representative. Subcontractors are responsible for notification involving their employees.

First aid/emergency equipment is available at the following locations:

First Aid Kit:	Contamination Reduction Zone
Eye Wash:	Contamination Reduction Zone
Fire Extinguisher	EA vehicle
Emergency Alarm:	Air horn (if required) in Contamination Reduction Zone.

The eye wash kit must be portable and capable of supplying at least a 15-minute supply of potable water to the eyes.

12.4 FIRE/EXPLOSION EMERGENCIES

Fire and explosion must be immediately recognized as an emergency. The Site Manager (or SSHO if the Site Manager is not available) must order evacuation and sound the emergency signal. Personnel must decontaminate and be evacuated to the predesignated evacuation location. If the emergency situation cannot be conveyed by word of mouth, an air horn will be sounded. One continuous blast of the air horn will be used as the emergency signal. The local emergency services must be notified. Only persons properly trained in fire suppression, spill control, and other emergency response procedures should attempt to deal with these situations. Other than small fires or spills, local emergency response services must be notified to handle the emergency. The Site Manager should take measures to reduce injury and illness, primarily by evacuating personnel as quickly as possible. He/she must then notify the CTO Manager. Cleanup after such events may require specialized services. The CTO Manager will determine proper cleanup actions. Site personnel will not resume work during or after a fire/explosion incident until the Site Manager has directed the incident is over and work may resume. During the incident, site personnel will remain outside the incident area and obey the instructions of the Site Manager.

12.5 EMERGENCY TELEPHONE NUMBERS

The directions to the nearest telephone and site-specific telephone numbers are listed in Table 5 and again in Appendix I.

13. CONFINED SPACE ENTRY PROCEDURES

No confined space entry is permitted or anticipated under this CTO.

14. SPILL CONTAINMENT PROCEDURES

Small incidental spills, i.e., those that cause no injury to personnel or the public, should be cleaned up quickly. For large spills, i.e., those that contaminate personnel or the environment, attend to first aid measures first, stop the source of the spill if possible, then notify the Program Manager and the Navy. The Site Manager (or the SSHO in his/her absence) will notify the CTO Manager as soon as possible. Spills of hazardous materials or wastes that are listed by EPA as having a reportable quantity value must be reported to appropriate federal, state, and local agencies if a reportable quantity or greater is released. It is the Navy's responsibility to contact other appropriate federal, state, and local agencies.

Emergency telephone numbers are provided in Table 5 and in Appendix I.

TABLE 1 LIST OF POTENTIAL ONSITE HAZARDOUS SUBSTANCES

PCBs
Pesticides
Herbicides
Diesel and Fuel Oil
Waste Oil
Gasoline
Ethylene Glycol
Freon
Lead Acid Batteries
Kerosene
Paint and Thinner/Solvents
Lead Paint
Cresols
Benzene
1.2-Dichlorobenzene
Ethylbenzene
PAH
Naphthalene
Xylene
Lead
Arsenic
Chromium
Magnesium
Manganese
Cadmium
Berrylium
Tetrachloroethene
1.2-Dichloroethane
Chlorobenzene
Trichloroethene
1.1.2.2-Tetrachloroethane
1.1.2-Trichloroethane
1.1.1-Trichloroethane
Bis(2-ethylhexyl)phthalate
Methylene Chloride
Acetone
Chloroform
2-Butanone
Toluene
4-Chloro-3-methylphenol
Phenol
Phthalate
Diethylphthalate
Pentachlorophenol
Phthalate
Diethylphthalate
Pentachlorophenol
Phthalate Esters

Table 1A	
Previously Detected Levels of Hazardous Substances	
Analyte	**Reported Maximum Concentrations - ppb**
Site 03 - Soil	
4,4-DDE	5.7
4,4-DDT	67
Acetone	65
Aroclor 1254	170
Aroclor 1260	80
Benzene	164000
Benzo(b)flouroethene	190
Bis(2-ethylhexyl)-phthalate	3300
Chloroform	2
Chromium	21800
Gamma-chlorodane	5.2
Lead	628000
Methylene chloride	9
OVA	3500
PAH	450
Petroleum Based Hydrocarbons	3110000
Pyrene	260
Tetrachloroethylene	814000
Tetrachloroethene	2.4 mg/l
TPH	57000000
Toluene	3
Site 03 - Water	
1,1,2-trichloroethane	9
1,1,2,2 tetrachloroethane	100
trichloroethene	210
1,2 dichloroethane	120
Bis(2-ethylhexyl)phthalate	570

Lead	21
Nickel	200
Total chlorinated VOCs	7782
VOCs	439
Site 09 - Soil	
1,1,1-trichloroethane	50
1,1,2,2-tetrachloroethane	640
1,2-dichloroethene	3,100
2,2'-oxybis(1-chloropropane)	65
2,3-dimethyl phenol	370
2,4-dimethylphenol	4,800
2-Butanone	11
4,4'-DDD	620
4,4'-DDE	890
4-Methylpenol	2,300
Acetone	180
Acetone/chloroform/PCBs	1,500
Aroclor-1260	30,000
Aromatic VOCs	209
Benzene	3
Beta-BHC	44
Bis (2-ethylhexyl) - phthalathe	10,000
Butyl benzyl phthalate	13,000
Cadmium	2,670
Carbazole	160,000
Carcinogenic PAH concentrations	424,300
Chlorinated VOC concentration	42
Chlorobenzene	180
Chloroform	16
Chromium	94,000
Di-n-butyl	410

Di-n-octyl phthalate	75
Dibenzofuran	120,000
Dichlorobenzene	180
Diethyl phthalate	4,300
Dimethyl phthalate	2,400
Ethylbenzene	38
Lead	33,700,000
Mercury	1,690
N-nitrosodiphenylamine	120
PAH compounds	6,025,000
PCB compounds	4,900
PCBs	3,400
Penthachlorophenol	98
Petroleum hydrocarbon	4,020,000
Phenols	4,000
Tetrachloroethene	12
Tetrachloroethylene	12
Toluene	82
Total 2,3,7,8-TCDD	0.0875
Total PAH concentrations	878,810
Total VOC	46
Total carcinogenic PAH	2,064,000
Total xylenes	4,500
Trichloroethene	670
Vinyl chloride	350
Xylenes	110
Site 09 - Water	
1,1,2-trichloroethane	48
1,2,2-Trichlorobenzene	70
1,2,4-Trichlorobenzene	8
1,2-dichloroethane	320
1,2-dichloroethene	28,000

1,2-dichloropropane	940
1,3-Dichlorobenzene	83
1,4-Dichlorobenzene	420
2,4-dimethylphenol	860
2-butanone	4,500
2-methylphenol	350
2-methynaphthalen	3
4,4' - DDE	5.7
4,4'-DDD	0.0037
4-methylphenol	370
Acetone	3,000
Alpha chlordane	0.012
Antimony	71
Aromatics VOCs	7,500
Benzene	11
Bis(2-chloroethyl)ther	3
Bis(2-chlorois)propyl	3
Cadmium	5.2
Chloride concentations	680
Chlorobenzene	620
Chloroethane	5
Dieldrin	0.0024
Ethylbenzene	31
Lead	25.5
Naphthalen	5
Petroleum hydrocarbons	900
Pentachlorophenol	2
Phenanthrene	21
Phenol	66
Salinity concentations	1,500,000
Sodium concentations	343,000
TDS concentrations	1,500,000

Tetrachloroethene	670
Total PAH concentrations	60
Total VOC concentrations	721
Trichloroethene	1,200
Vinyl chloride	7,000
Xylenes	55

* Denotes that contamination levels are suspected to be caused from laboratory procedures

TABLE 1B
POTENTIAL HAZARDOUS SUBSTANCES
IR Program Sites 03 and 09
NCBC-Davisville

Substance	Maximum Levels in Media (soil, water, air)	PEL(2) or TVL(3)STEL(4)	IDLH(l)	Route of Exposure	Symptoms
Volatile Organic Compounds (VOC)					
Petroleum Products					
Kerosene	Unknown	200 ppm (3) 2500 mg/m^3 (4) for 60 min	Unknown	Ing, Inh	Irritation of upper raspatory tract, CNS stimulation followed by depression, dizziness, headache, incoordination, coma, irregular heartbeat, respiratory arrest; Irritation of mucous membranes of throat, esophagus, and stomach, irr. heartbeat
Automotive Gasoline	Unknown	300 ppm (3) 500 ppm (4) for 30 min	Unknown	Ing, Inh	Same
Other Products					
benzene	164 ppm	1 ppm	3000 ppm ca	Ing, Inh, Con, Abs	irritant; eyes, nose, raspatory system
1,1,2,2-tetrachloroethane	0.1 ppm	1 ppm	150 ppm ca	same	nausea, vomit, abdom pain, tremor fingers, juand, enlareged tend liver, monocyc, kidney damage.
1,2-dichloroethene	28 ppm	200 ppm	4000 ppm	Ing. Inh, Con	irritant to eyes and respiratory tract, CNS depression
1,2-dichlorethane	0.320 ppm	10 ppm	1000 ppm ca	Ing, Inh, Con, Abs	CNS depressant, nausea, dermatitis, irritant to eyes
trichloroethene	0.210 ppm	25 ppm	1000 ppm ca	Ing, Inh,Con	head, verti, vis dist, tremors, som, nau, vomit, irrit eyes, derm, card arrhy, pares:(carc)

TABLE 1B (cont)

tetrachloroethylene (PCE) vinyl chloride	814 ppm 7 ppm	25 ppm 1 ppm	500 ppm ca unknown ca	same Inh	irritant eyes, nose, throat, nau, flush face, neck: verti, dizz, inco, head, skin eryt, liver damage. weakness, abdom pain, gastrointestinal bleeding
Semivolatile Organic Compounds (SVOC)					
PAHs	879 ppm	0.2 mg/m^3 (as Coal tar VOCs)	700 mg/m^3; Ca	Inh, Abs, Ing	Dermatitis, bronchitis, carcinogen
dibenzofuran	120 ppm	not established	not established	Inh, Abs, Ing	unknown
Pesticides/PCB					
PCBs	30 ppm	0.001 mg/m^3, (TWA) 0.5 mg/m^3 (skin)	5 mg/m^3; Ca	Inh, Abs, Ing, Con	Irritation to eyes and skin, chloracne, liver damage
Aroclor-1260	30 ppm	0.001 mg/m^3, (TWA) 0.5 mg/m^3 (skin)	5 mg/m^3; Ca	Inh, Abs, Ing, Con	Irritation to eyes and skin, chloracne, liver damage
Inorganic Analytes					
Chromium	94 ppm	1 (mg/m^3)[5]	not established	Inh, Ing	histologic fibrosis of the lungs
Lead	33,700 ppm	NIOSH: 0.10 mg/m^3 OSHA: 0.05 (mg/m^3)[6]	700 mg/m^3	Inh, Ing, Con	Weakness, lassitude, insomnia, facial pallor, tremor, anorexia, weight loss, constipation, abdominal pain, colic, anemia, gingival lead line, wrist/ankle paralysis, irritated eyes, hypotension

TABLE 1B (cont)

Pesticides					
2,3,7,8- TCDD (dioxin)	0.0875 ppm	not established	unknown ca	unknown	chloracne, tumors

(1) IDLH Immediately Dangerous to Life and Health
(2) PEL Permissible Exposure Limit
(3) TLV Threshold Limit Value
(4) STEL Short Term Exposure Limit (15 min)
(5) Determined for chromium metal
(6) Determined for metal form

C Ceiling Limit
Ca Carcinogen
Skin Potential Exposure by cataneous route

TABLE 3 SITE WORKER TRAINING AND PHYSICAL EXAMINATION RECORD

SITE: Naval Construction Battalion Center, Davisville Project No. 29600.32
CTO NO.: 0032

Name	HAZWOPER 40-Hour Initial	HAZWOPER Annual	First Aid[a]	CPR[a]	Supervisor[b]	Medical Exam	Fit-Test[c]
Randi Augustine	1985	May 94	June 93	Mar 94	Jan 92	April 94	Apri 94
Susan Braun	1990	April 94	_	Mar 94	Feb 92	Oct 93	-
Kevin Caldwell	Feb 90	Dec 93	Feb 93	June 94	-	Jan 94	Jan 94
George Lukert	Nov 90	May 94	July 92	Feb 94	June 92	April 94	April 94
Joseph Friesen	Aug 93	Oct 94	_	July 94	_	Sept 94	_
Nicholas Lanney	Feb 94	May 94	_	_	_	Apr 94	_

(a) At least two people onsite must have current certification in First Aid/CPR for all tasks.
(b) At a minimum, the SSHO or Site Manager must have had supervisor's training.
(c) When air-purifying respirators are required.

NOTE: No employees other than those listed above are permitted to work onsite without prior written approval by the CTO Manager or SSHO.

TABLE 4 PERSONAL PROTECTIVE EQUIPMENT REQUIREMENTS

SITE: Naval Construction Battalion Center, Davisville CTO NO.: 0032		Project No. 29600.32

Work Task	Initial Level of Protection	Specific Personal Protective Equipment
Drilling Monitoring Well Installation Groundwater Sampling Soil Sampling	D	Steel toe/steel shank safety boots, cotton coveralls, safety glasses, hardhat (drilling only), latex inner gloves, butyl/neoprene outer gloves [(a)], faceshield (drilling operator only), hearing protection (during drilling only)

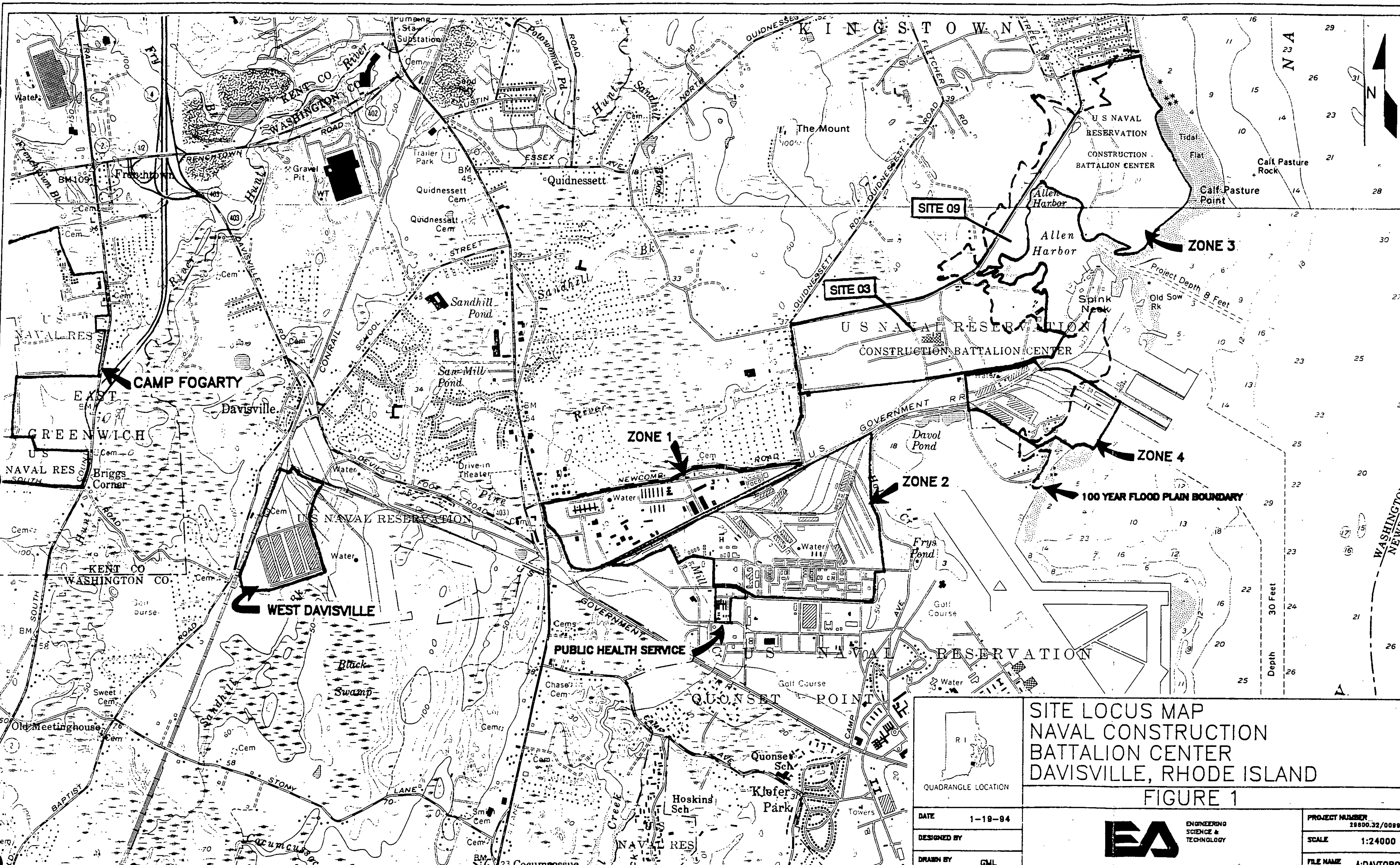
(a) Work gloves may be worn during drilling. Nitrile/neoprene outer gloves and latex inner gloves are to be worn during tidal monitoring and when contact with contaminated soil or ground water.

TABLE 5 EMERGENCY INFORMATION

SITE: Naval Construction Battalion Center, Davisville CTO NO.: 0032	Project No. 29600.32
Nearest telephone (give location, directions, and telephone number): Building No. 404, East of the intersection of Davisville Rd and Route 1.	
Other site communication equipment: Cellular telephone in EA vehicle	
Name	**Phone Number**
Police: 8166 Post Road, N. Kingstown	(401) 294-3311
Fire: 8150 Post Road	(401) 294-3344
Ambulance: 8150 Post Road	(401) 294-3344
Hospital: Kent County Memorial Hospital, 445 Toll Gate Rd, Warwick	(401) 737-7000
Security:	(401) 267-2541
Directions to Hospital: Exit NCBC Davisville by traveling west on Davisville Road. Proceed to entrance of NCBC Davisville. Proceed under Route 2 overpass onto Devil's Food Road. Continue approximately 2 miles on Devil's Food Road and turn right onto Route 4 North. Take Route 4 North to Route 95 North. Take the first exit off of Route 95 onto Route 117. Take a left onto Route 117. Proceed one block to a traffic light and turn right. Follow road and bear right at first intersection. Follow road to the end and take a left onto Toll Gate Road. Hospital will be on your right.	
NATIONAL RESPONSE CENTER: **1-800-424-8802**	
NAVFAC Remedial Project Manager: Robert Krivinskas	1-(610) 595-0567 ext. 134
NCBC Davisville CSO: Lou Fayan	1-(401) 294-6108
CTO Manager: Nick Lanney	1-(617) 784-1767
Site Manager: George Lukert	1-(617) 784-1767
Site Safety and Health Officer: Susan Braun	1-(617) 784-1767
Program Manager Charles Houlik, Ph.D., CPG	(410) 771-4950 (work)
Deputy Program Manager Sam Morekas	(410) 771-4950 (work)
Program Safety and Health Officer Kris Hoiem, CIH	(410) 771-4950 (work) (410) 357-5485 (home)
EA Corporate Safety and Health Officer Clayton Bock	(410) 584-7000 (work)
EA Medical Services Medical College Hospital, Bucks County Campus Warminister General Hospital 225 Newtown Road Warminister, Pennsylvania 18974	(215) 441-6600
Poison Control Center	(800) 822-9761
In case of accident or exposure, contact the EA Human Resources representative within 24 hours: Toni Sircely	(410) 584-7000

NOTE: The CTO manager will verify telephone numbers and check with the emergency responder to ensure coordination. The medical facility will be contacted to determine the ability and desire to treat potentially contaminated patients.

FIGURES

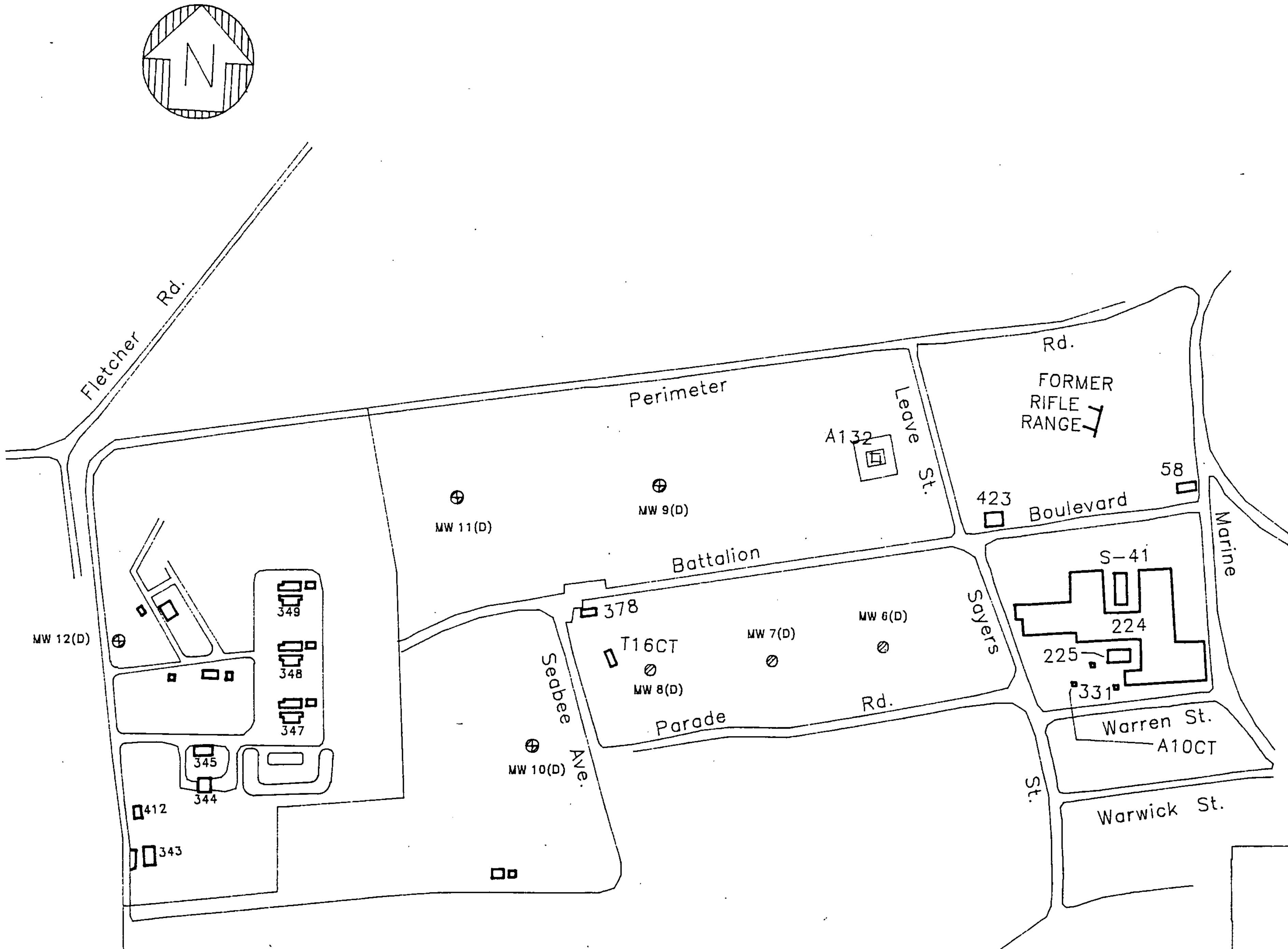


QUADRANGLE LOCATION	SITE LOCUS MAP NAVAL CONSTRUCTION BATTALION CENTER DAVISVILLE, RHODE ISLAND

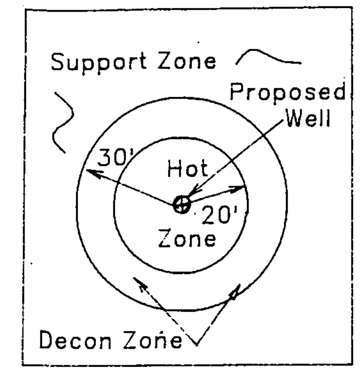
FIGURE 1

DATE	1-19-94	EA ENGINEERING SCIENCE & TECHNOLOGY	PROJECT NUMBER	29600.32/0099
DESIGNED BY			SCALE	1:24000
DRAWN BY	GML		FILE NAME	A:DAVTOPO
CHECKED BY	GML	SHARON COMMERCE CENTER 2 COMMERCIAL STREET, SUITE 106 SHARON, MASSACHUSETTS 02067 (617) 784-1767	DRAWING NUMBER	
PROJECT MANAGER	NAL		SHEET NUMBER	

BASE MAP: U.S.G.S. EAST GREENWICH AND WICKFORD QUADRANGLE – RHODE ISLAND
7.5 MINUTE SERIES (TOPOGRAPHIC) 1942, PHOTOREVISED 1970 & 1975.



Work Zones Detail

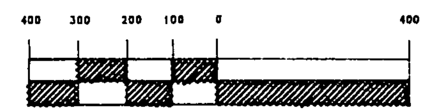


LEGEND

⊘ EXISTING WELL

⊕ PROPOPSED WELL

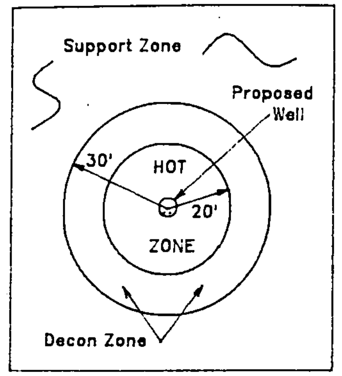
SCALE in FEET
(Approximate)

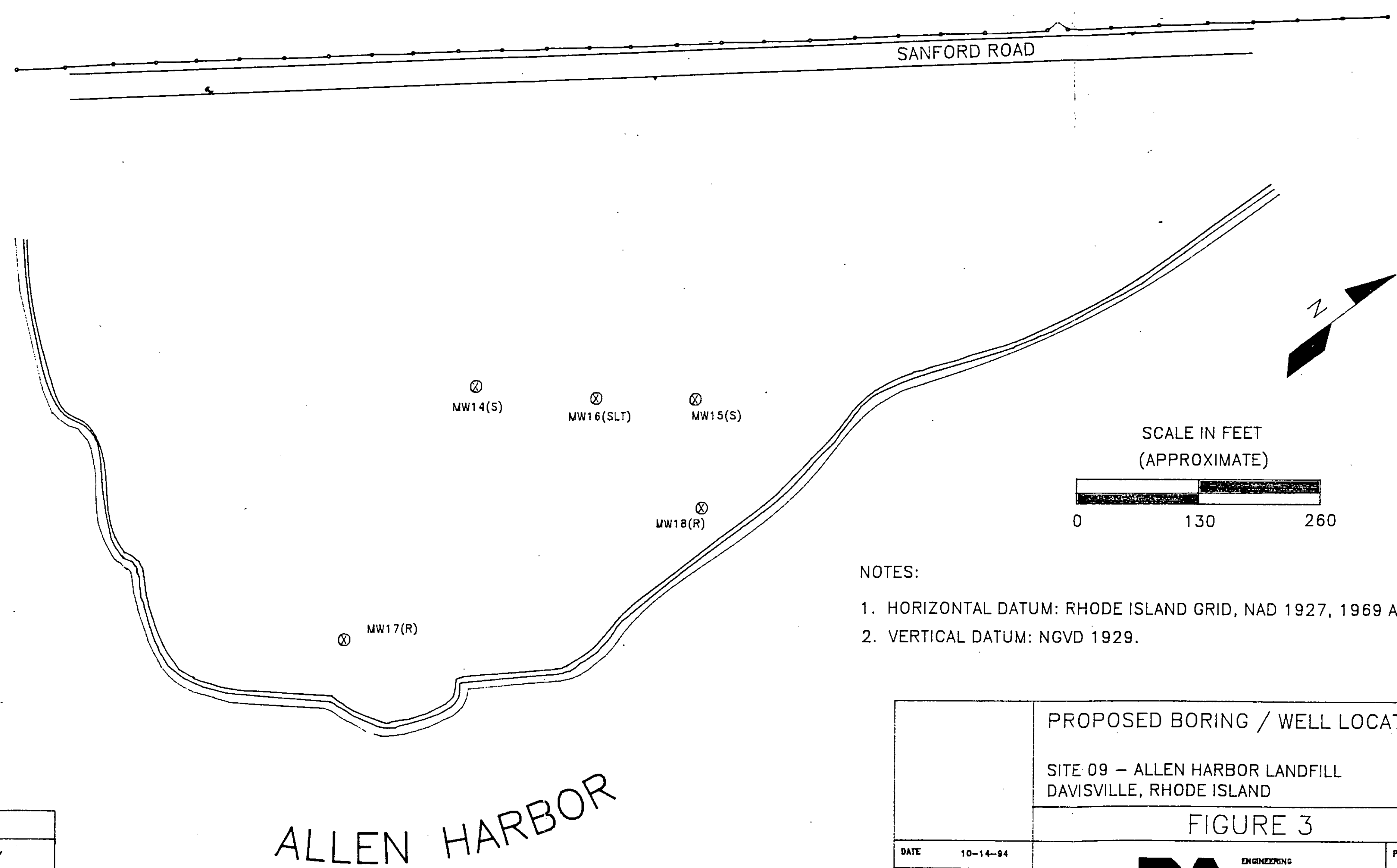


Boring Location Plan IR Program Site 03 NCBC–Davisville, Rhode Island	
FIGURE 2	

DATE	9/26/94	EA ENGINEERING SCIENCE AND TECHNOLOGY	PROJECT NUMBER 29600.32
DESIGNED BY	CML		SCALE 1"=400'
DRAWN BY	JMF		FILE NAME A:\davis.dw2
CHECKED BY	NAL	SHARON COMMERCE CENTER 2 COMMERCIAL STREET, SUITE 106 SHARON, MASSACHUSETTS 02067 (617) 784-1767	DRAWING NUMBER
PROJECT MANAGER	NAL		SHEET NUMBER 1 OF 1

Work Zone Detail





NOTES:

1. HORIZONTAL DATUM: RHODE ISLAND GRID, NAD 1927, 1969 ADJUSTMENT.
2. VERTICAL DATUM: NGVD 1929.

LEGEND
ⓧ............ PROPOSED BORING/ WELL LOCATIONS

SOURCE: BASE MAP MODIFIED FROM FIGURES 2–2 AND 2–3 OF THE TRC DRAFT ALLEN HARBOR LANDFILL REMEDIAL INVESTIGATION REPORT, VOLUME 1, NOVEMBER 1993.

PROPOSED BORING / WELL LOCATIONS

SITE 09 – ALLEN HARBOR LANDFILL
DAVISVILLE, RHODE ISLAND

FIGURE 3

DATE	10-14-94
DESIGNED BY	GML
DRAWN BY	GML
CHECKED BY	JAS
PROJECT MANAGER	JAS

EA ENGINEERING SCIENCE AND TECHNOLOGY

SHARON COMMERCE CENTER
2 COMMERCIAL STREET, SUITE 108
SHARON, MASSACHUSETTS 02067
(617) 784-1767

PROJECT NUMBER	29600.32/0099
SCALE	AS SHOWN
FILE NAME	A:ALLEN2
DRAWING NUMBER	
SHEET NUMBER	

Appendix A

Site Safety and Health Review Record

APPENDIX A

SITE SAFETY AND HEALTH PLAN REVIEW RECORD

SITE: Naval Construction Battalion Center, Davisville — Project No. 29600.32
CTO NO.: 0032

I have read the Site Safety, Health, and Emergency Response Plan for this site and have been briefed on the nature, level, and degree of exposure anticipated as a result of participation in this project. I agree to conform to the requirements of this Plan.

Name	Signature	Affiliation	Date

Appendix B

Hazardous Substances List

Methanol
Alconox
Non-phosphate detergent
Isobutylene

Appendix C

Material Safety Data Sheets

Material Safety Data Sheet

ALCONOX POWDER DETERGENT

U.S. Department of Labor

Occupational Safety and Health Administration

OMB No. 1218-0072

Expiration Date 05/31/88

PREPARED 1/2/85

Manufacturer's Name

ALCONOX, INC.

Emergency Telephone Number

(212) 473-1300

Address (Number, Street, City, State, and ZIP Code)

215 PARK AVENUE SOUTH

NEW YORK, N.Y. 10003

Chemical Name and Synonyms: N.A.

Trade Name and Synonyms: ALCONOX

Chemical Family: ANIONIC DETERGENT

Formula: N.A.

Paints, Preservatives, and Solvents

	%	TLV (Units)
NONE		
NONE		
NONE		
NONE		
NONE		
NONE		

Alloys and Metallic Coatings

	%	TLV (Units)
Base Metal: NONE		
Alloys: NONE		
Metallic Coatings: NONE		
Filler Metal Plus Coating or Core Flux: NONE		
Others: NONE		

Mixtures of Other Liquids, Solids, or Gases

	%	TLV (Units)
ONE		

AUG

Physical Data

	N.A.	Specific Gravity (H_2O=1)	N.A.
	N.A.	Percent Volatile by Volume (%)	N.A.
	N.A.	Evaporation Rate	N.A.

Solubility in Water: APPRECIABLE

Appearance and Odor: WHITE POWDER INTERSPERSED WITH CREAM COLORED FLAKES - ODORLESS

Fire and Explosion Hazard Data

Flash Point (Method Used): NONE

Flammable Limits: N.A. | Lel: N.A. | Uel: N.A.

Extinguishing Media: WATER, CO_2, DRY CHEMICAL, FOAM, SAND/EARTH

Special Fire Fighting Procedures

FOR FIRES INVOLVING THIS MATERIAL, DO NOT ENTER WITHOUT PROTECTIVE EQUIPMENT AND SELF CONTAINED BREATHING APPARATUS

Unusual Fire and Explosion Hazards

NONE

Section V - Health Hazard Data

Threshold Limit Value

NO DATA AVAILABLE - TREAT AS NUISANCE DUST

Effects of Overexposure

PROLONGED EXPOSURE TO DUST MAY IRRITATE MUCOUS MEMBRANES

Emergency First Aid Procedures

EYES - FLUSH WITH PLENTY OF WATER FOR 15 MINUTES. SKIN-FLUSH WITH PLENTY OF WATER. INGESTION - DRINK LARGE QUANTITIES OF WATER TO DILUTE MATERIAL. GET MEDICAL ATTENTION FOR DISCOMFORT.

Section VI - Reactivity Data

Stability		Conditions to Avoid
Unstable		NONE
Stable	X	

Incompatibility (Materials to Avoid)

AVOID STRONG ACIDS

Hazardous Decomposition Products

MAY RELEASE CO_2 GAS ON BURNING

Hazardous Polymerization		Conditions to Avoid
May Occur		NONE
Will Not Occur	X	

Section VII - Spill or Leak Procedures

Steps to be Taken in Case Material is Released or Spilled

MATERIAL FOAMS PROFUSELY. SHOVEL AND RECOVER AS MUCH AS POSSIBLE. RINSE REMAINDER TO SEWER. MATERIAL IS COMPLETELY BIODEGRADABLE.

Waste Disposal Method

SMALL QUANTITIES MAY BE DISPOSED OF IN SEWER. LARGE QUANTITIES SHOULD BE DISPOSED OF ACCORDING TO LOCAL REQUIREMENTS FOR NON-HAZARDOUS DETERGENT.

Section VIII - Special Protection Information

Respiratory Protection (Specify Type)

DUST MASK

Ventilation		
Local Exhaust: NORMAL	Special: N.A.
Mechanical (General): N.A.	Other: N.A.

Protective Gloves: USEFUL - NOT REQUIRED

Eye Protection: USEFUL - NOT REQUIRED

Other Protective Equipment

NOT REQUIRED

Section IX - Special Precautions

Precautions to be Taken in Handling and Storing

SHOULD BE STORED IN A DRY AREA TO PREVENT CAKING

Other Precautions

NO SPECIAL REQUIREMENTS OTHER THAN THE GOOD INDUSTRIAL HYGIENE AND SAFETY PRACTICES EMPLOYED WITH ANY INDUSTRIAL CHEMICAL.

DATE: [redacted]/30/91 ACCT: 098215-01 PAGE: 1
INDEX [redacted]01060856 CAT NO: A4114 PO NBR: N/A

METHANOL
METHANOL
METHANOL

MATERIAL SAFETY DATA SHEET

FISHER SCIENTIFIC
CHEMICAL DIVISION
1 REAGENT LANE
FAIR LAWN NJ 07410
(201) 796 7100

EMERGENCY NUMBER: (201) 796-7100
CHEMTREC ASSISTANCE: (800) 424-9300

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SUBSTANCE IDENTIFICATION

CAS-NUMBER 67-56-1

SUBSTANCE: **METHANOL**

TRADE NAMES/SYNONYMS:
METHYL ALCOHOL; WOOD ALCOHOL; METHYL HYDROXIDE; CARBINOL; MONOHYDROXYMETHANE; WOOD SPIRIT; WOOD NAPHTHA; METHYLOL; COLONIAL SPIRIT; COLUMBIAN SPIRIT; PYROXYLIC SPIRIT; COULOMATIC (R) CONDITIONER SOLUTION; STANDARD WATER IN METHANOL; STCC 4909230; UN 1230; RCRA U154; A454; A452; A936; A408; A947; A935; BP1105; A412; A411; A433P; SW2;; SC95; A452SK; A406SK; A516; A412P; A434; A412SK; A451SK; A453; CH4O; ACC14280

CHEMICAL FAMILY:
HYDROXYL, ALIPHATIC

MOLECULAR FORMULA: C-H3-O-H

MOLECULAR WEIGHT: 32.04

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=3 REACTIVITY=0 PERSISTENCE=0
NFPA RATINGS (SCALE 0-4): HEALTH=1 FIRE=3 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: METHYL ALCOHOL (METHANOL) PERCENT: 100
CAS# 67-56-1

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:
METHYL ALCOHOL (METHANOL):
200 PPM (262 MG/M3) OSHA TWA (SKIN); 250 PPM (328 MG/M3) OSHA STEL
200 PPM (262 MG/M3) ACGIH TWA (SKIN); 250 PPM (328 MG/M3) ACGIH STEL
200 PPM (262 MG/M3) NIOSH RECOMMENDED TWA (SKIN);
250 PPM (328 MG/M3) NIOSH RECOMMENDED STEL
200 PPM (262 MG/M3) DFG MAK TWA (SKIN);
400 PPM (524 MG/M3) DFG MAK 30 MINUTE PEAK, AVERAGE VALUE, 4 TIMES/SHIFT

MEASUREMENT METHOD: SILICA GEL TUBE; WATER; GAS CHROMATOGRAPHY WITH FLAME IONIZATION DETECTION; (NIOSH VOL. III # 2000, METHANOL).

5000 POUNDS CERCLA SECTION 103 REPORTABLE QUANTITY
SUBJECT TO SARA SECTION 313 ANNUAL TOXIC CHEMICAL RELEASE REPORTING

PHYSICAL DATA

DESCRIPTION: CLEAR, COLORLESS LIQUID WITH A CHARACTERISTIC ALCOHOLIC ODOR.

BOILING POINT: 149 F (65 C) MELTING POINT: -137 F (-94 C)

SPECIFIC GRAVITY: 0.7914 VAPOR PRESSURE: 97.25 MMHG @ 20 C

EVAPORATION RATE: (BUTYL ACETATE=1) 4.6 SOLUBILITY IN WATER: SOLUBLE

ODOR THRESHOLD: 100 PPM VAPOR DENSITY: 1.11

SOLVENT SOLUBILITY: ETHER, BENZENE, ALCOHOL, ACETONE, CHLOROFORM, ETHANOL

VISCOSITY: 0.59 CPS @ 20 C

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
DANGEROUS FIRE HAZARD WHEN EXPOSED TO HEAT, FLAME, OR OXIDIZERS.

VAPOR AIR MIXTURES ARE EXPLOSIVE.

FLASH POINT: [illegible] (11 C) (CC)   UPPER EXPLOSIVE LIMIT: 36.0%

LOWER EXPLOSIVE LIMIT: 6.0%   AUTOIGNITION TEMP.: 725 F (385 C)

FLAMMABILITY CLASS(OSHA): IB

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, WATER SPRAY OR ALCOHOL-RESISTANT FOAM (1990 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.5).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR ALCOHOL-RESISTANT FOAM (1990 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.5).

FIREFIGHTING:
MOVE CONTAINER FROM FIRE AREA IF YOU CAN DO IT WITHOUT RISK. DIKE FIRE-CONTROL WATER FOR LATER DISPOSAL; DO NOT SCATTER THE MATERIAL. APPLY COOLING WATER TO SIDES OF CONTAINERS THAT ARE EXPOSED TO FLAMES UNTIL WELL AFTER FIRE IS OUT. STAY AWAY FROM ENDS OF TANKS. WITHDRAW IMMEDIATELY IN CASE OF RISING SOUND FROM VENTING SAFETY DEVICE OR ANY DISCOLORATION OF TANK DUE TO FIRE. ISOLATE FOR 1/2 MILE IN ALL DIRECTIONS IF TANK, RAIL CAR OR TANK TRUCK IS INVOLVED IN FIRE (1990 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.5, GUIDE PAGE 28).

EXTINGUISH ONLY IF FLOW CAN BE STOPPED; USE WATER IN FLOODING AMOUNTS AS FOG. SOLID STREAMS MAY NOT BE EFFECTIVE. COOL CONTAINERS WITH FLOODING QUANTITIES OF WATER. APPLY FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING TOXIC VAPORS, KEEP UPWIND.

TRANSPORTATION DATA

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49 CFR 172.101:
FLAMMABLE LIQUID

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49 CFR 172.101 AND SUBPART E:
FLAMMABLE LIQUID

DEPARTMENT OF TRANSPORTATION PACKAGING REQUIREMENTS: 49 CFR 173.119
EXCEPTIONS: 49 CFR 173.118

TOXICITY

METHYL ALCOHOL (METHANOL):
IRRITATION DATA: 20 MG/24 HOURS SKIN-RABBIT MODERATE; 40 MG EYE-RABBIT MODERATE; 100 MG/24 HOURS EYE-RABBIT MODERATE.
TOXICITY DATA: 86,000 MG/M3 INHALATION-HUMAN TCLO; 300 PPM INHALATION-HUMAN TCLO; 64,000 PPM/4 HOURS INHALATION-RAT LC50; 1000 PPM INHALATION-MONKEY LCLO; 50 GM/M3/2 HOURS INHALATION-MOUSE LCLO; 44,000 MG/M3/6 HOURS INHALATION-CAT LCLO; 15,800 MG/KG SKIN-RABBIT LD50; 393 MG/KG SKIN-MONKEY LDLO; 428 MG/KG ORAL-HUMAN LDLO; 143 MG/KG ORAL-HUMAN LDLO; 6422 MG/KG ORAL-MAN LDLO; 3429 MG/KG ORAL-MAN TDLO; 4 GM/KG ORAL-WOMAN TDLO; 7 GM/KG ORAL-MONKEY LD50; 5628 MG/KG ORAL-RAT LD50; 7300 MG/KG ORAL-MOUSE LD50; 14,200 MG/KG ORAL-RABBIT LD50; 7500 MG/KG ORAL-DOG LDLO; 9800 MG/KG SUBCUTANEOUS-MOUSE LD50; 2131 MG/KG INTRAVENOUS-RAT LD50; 4710 MG/KG INTRAVENOUS-MOUSE LD50; 8907 MG/KG INTRAVENOUS-RABBIT LD50; 7529 MG/KG INTRAPERITONEAL-RAT LD50; 10,765 MG/KG INTRAPERITONEAL-MOUSE LD50; 1826 MG/KG INTRAPERITONEAL-RABBIT LD50; 59 GM/KG PARENTERAL-FROG LDLO; 868 MG/KG UNREPORTED-MAN LDLO; MUTAGENIC DATA (RTECS); REPRODUCTIVE EFFECTS DATA (RTECS).
CARCINOGEN STATUS: NONE.
LOCAL EFFECTS: IRRITANT- SKIN, EYE.
ACUTE TOXICITY LEVEL: SLIGHTLY TOXIC BY INHALATION, DERMAL ABSORPTION, INGESTION.
TARGET EFFECTS: CENTRAL NERVOUS SYSTEM DEPRESSANT; NEUROTOXIN.
AT INCREASED RISK FROM EXPOSURE: PERSONS WITH KIDNEY, EYE OR SKIN DISORDERS.

HEALTH EFFECTS AND FIRST AID

[illegible] FROM OCCUPATIONAL EXPOSURE INCLUDE PARESTHESIAS, NUMBNESS AND SHOOTING PAINS IN THE HANDS AND FOREARMS. METABOLIC ACIDOSIS, [illegible] EFFECTS ON THE EYES AND CENTRAL NERVOUS SYSTEM MAY OCCUR AS DETAILED [illegible]TE INGESTION.
CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE MAY CAUSE EFFECTS AS IN ACUTE INGESTION. REPEATED EXPOSURE TO 200-375 PPM CAUSED RECURRENT HEADACHES IN WORKERS. EXPOSURE FOR 4 YEARS TO 1200-8000 PPM RESULTED IN MARKED DIMINUTION OF VISION AND ENLARGEMENT OF THE LIVER IN A WORKMAN. REPRODUCTIVE EFFECTS HAVE BEEN REPORTED IN ANIMALS.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP PERSON WARM AND AT REST. TREAT SYMPTOMATICALLY AND SUPPORTIVELY. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
METHYL ALCOHOL (METHANOL):
IRRITANT/NARCOTIC/NEUROTOXIN.
ACUTE EXPOSURE- CONTACT WITH LIQUID MAY CAUSE IRRITATION. SKIN ABSORPTION MAY OCCUR AND CAUSE METABOLIC ACIDOSIS AND EFFECTS ON THE EYES AND CENTRAL NERVOUS SYSTEM AS DETAILED IN ACUTE INGESTION.
CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT WITH THE LIQUID MAY CAUSE DEFATTING OF THE SKIN RESULTING IN ERYTHEMA, SCALING, AND ECZEMATOID DERMATITIS. CHRONIC ABSORPTION MAY RESULT METABOLIC ACIDOSIS AND EFFECTS AS DETAILED IN ACUTE INGESTION.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
METHYL ALCOHOL (METHANOL):
IRRITANT.
ACUTE EXPOSURE- VAPORS MAY CAUSE IRRITATION. HIGH CONCENTRATIONS HAVE BEEN REPORTED TO CAUSE VIOLENT INFLAMMATION OF THE CONJUNCTIVA AND EPITHELIAL DEFECTS ON THE CORNEA. MILD IRRITATION MAY OCCUR WITH DILUTE SOLUTIONS; THE UNDILUTED LIQUID HAS PRODUCED MODERATE CORNEAL OPACITY AND CONJUNCTIVAL REDNESS IN RABBITS. APPLICATION OF A DROP OF METHANOL IN RABBIT EYES CAUSED A MILD REVERSIBLE REACTION, GRADED 3 ON A SCALE OF 1-10 AFTER 24 HOURS.
CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT MAY CAUSE CONJUNCTIVITIS.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER OR NORMAL SALINE, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
METHYL ALCOHOL (METHANOL):
NARCOTIC/NEUROTOXIN.
ACUTE EXPOSURE- MAY CAUSE MILD AND TRANSIENT INEBRIATION AND SUBSEQUENT DROWSINESS FOLLOWED BY AN ASYMPTOMATIC PERIOD LASTING 8-48 HOURS. FOLLOWING THE DELAY, COUGHING, DYSPNEA, HEADACHE, DULLNESS, WEAKNESS, VERTIGO OR DIZZINESS, NAUSEA, VOMITING, OCCASIONAL DIARRHEA, ANOREXIA, VIOLENT PAIN IN THE BACK, ABDOMEN, AND EXTREMITIES, RESTLESSNESS, APATHY OR DELIRIUM, AND RARELY, EXCITEMENT AND MANIA MAY OCCUR. RAPID, SHALLOW RESPIRATION DUE TO METABOLIC ACIDOSIS, COLD AND CLAMMY SKIN, HYPOTENSION, CYANOSIS, OPISTHOTONOS, CONVULSIONS, MILD TACHYCARDIA, CARDIAC DEPRESSION, PERIPHERAL NEURITIS, CEREBRAL AND PULMONARY EDEMA, UNCONSCIOUSNESS, AND COMA ARE POSSIBLE. EFFECTS ON THE EYE MAY INCLUDE OPTIC NEURITIS, BLURRED OR DIMMED VISION, DILATED, UNRESPONSIVE PUPILS, PTOSIS, EYE PAIN, CONCENTRIC CONSTRICTION OF VISUAL FIELDS, DIPLOPIA, CHANGE IN COLOR PERCEPTION, PHOTOPHOBIA, AND OPTIC NERVE ATROPHY. PARTIAL BLINDNESS OR POSSIBLY DELAYED TRANSIENT OR PERMANENT BLINDNESS MAY OCCUR. BILATERAL SENSORINEURAL DEAFNESS HAS BEEN REPORTED IN A SINGLE CASE. LIVER, KIDNEY, HEART, STOMACH, INTESTINAL AND PANCREATIC DAMAGE MAY ALSO OCCUR. DEATH MAY BE DUE TO RESPIRATORY FAILURE OR RARELY FROM CIRCULATORY COLLAPSE. AS LITTLE AS 15 ML HAS CAUSED BLINDNESS; THE USUAL FATAL DOSE IS 60-240 ML. PROLONGED ASTHENIA AND IRREVERSIBLE EFFECTS ON THE NERVOUS SYSTEM INCLUDING DIFFICULTY IN SPEECH, MOTOR DYSFUNCTION WITH RIGIDITY, SPASTICITY, AND HYPOKINESIS HAVE BEEN REPORTED.
CHRONIC EXPOSURE- REPEATED INGESTION MAY CAUSE VISUAL IMPAIRMENT AND BLINDNESS AND OTHER SYSTEMIC EFFECTS AS DETAILED IN ACUTE INGESTION. REPRODUCTIVE EFFECTS HAVE BEEN REPORTED IN ANIMALS.

FIRST AID- IF INGESTION OF METHANOL IS DISCOVERED WITHIN 2 HOURS, GIVE SYRUP OF IPECAC. LAVAGE THOROUGHLY WITH 2-4 L OF TAP WATER WITH SODIUM BICARBONATE (20 G/L) ADDED. GET MEDICAL ATTENTION IMMEDIATELY. LAVAGE SHOULD BE PERFORMED BY QUALIFIED MEDICAL PERSONNEL (DREISBACH, HANDBOOK OF POISONING, 12TH ED.).

ANTIDOTE:
THE FOLLOWING ANTIDOTE(S) HAVE BEEN RECOMMENDED. HOWEVER, THE DECISION AS TO WHETHER THE SEVERITY OF POISONING REQUIRES ADMINISTRATION OF ANY TIL AND
ACTUAL DOSE REQUIRED SHOULD BE MADE BY QUALIFIED MEDICAL PERSONNE

METHANOL POISONING:
GIVE ETHANOL, 50% (100 PROOF), 1.5 ML/KG ORALLY INITIALLY, DILUTED TO NOT MORE THAN 5% SOLUTION, FOLLOWED BY 0.5-1.0 ML/KG EVERY 2 HOURS ORALLY OR INTRAVENOUSLY FOR 4 DAYS IN ORDER TO REDUCE METABOLISM OF METHANOL AND TO ALLOW TIME FOR ITS EXCRETION. BLOOD ETHANOL LEVEL SHOULD BE IN THE RANGE OF 1-1.5 MG/ML (DREISBACH, HANDBOOK OF POISONING, 12TH ED.). ANTIDOTE SHOULD BE ADMINISTERED BY QUALIFIED MEDICAL PERSONNEL.

ORAL OR INTRAVENOUS ADMINISTRATION OF 4 METHYLPYRAZOLE INHIBITS ALCOHOL DEHYDROGENASE AND HAS BEEN USED EFFECTIVELY AS AN ANTIDOTE FOR METHANOL OR ETHYLENE GLYCOL POISONING (ELLENHORN AND BARCELOUX, MEDICAL TOXICOLOGY).

REACTIVITY:
STABLE UNDER NORMAL TEMPERATURES AND PRESSURES.

INCOMPATIBILITIES:
METHYL ALCOHOL (METHANOL):
- ACETYL BROMIDE: VIOLENT REACTION WITH FORMATION OF HYDROGEN BROMIDE.
- ALKYLALUMINUM SOLUTIONS: VIOLENT REACTION.
- ALUMINUM: CORRODES.
- BARIUM PERCHLORATE: DISTILLATION YIELDS HIGHLY EXPLOSIVE ALKYL PERCHLORATE.
- BERYLLIUM HYDRIDE: VIOLENT REACTION, EVEN AT -196 C.
- BROMINE: VIGOROUSLY EXOTHERMIC REACTION.
- CALCIUM CARBIDE: VIOLENT REACTION.
- CHLORINE: POSSIBLE IGNITION AND EXPLOSION HAZARD.
- CHLOROFORM AND SODIUM HYDROXIDE: EXPLOSIVE REACTION.
- CHROMIUM TRIOXIDE (CHROMIC ANHYDRIDE): POSSIBLE IGNITION.
- CYANURIC CHLORIDE: VIOLENT REACTION.
- DICHLOROMETHANE: POSSIBLE IGNITION AND EXPLOSION.
- DIETHYL ZINC: POSSIBLE IGNITION AND EXPLOSION.
- HYDROGEN PEROXIDE + WATER: EXPLOSION HAZARD.
- IODINE + ETHANOL + MERCURIC OXIDE: EXPLOSION HAZARD.
- LEAD: CORRODES.
- LEAD PERCHLORATE: EXPLOSION HAZARD.
- MAGNESIUM: VIOLENT REACTION.
- MAGNESIUM (POWDERED): MIXTURES ARE CAPABLE OF DETONATION.
- METALS: INCOMPATIBLE.
- NICKEL: POSSIBLE IGNITION IN THE PRESENCE OF NICKEL CATALYST.
- NITRIC ACID (CONCENTRATED): MIXTURES OF GREATER THAN 25% ACID MAY DECOMPOSE VIOLENTLY.
- OXIDIZERS (STRONG): FIRE AND EXPLOSION HAZARD.
- PERCHLORIC ACID: EXPLOSION HAZARD.
- PHOSPHOROUS TRIOXIDE: POSSIBLE VIOLENT REACTION AND IGNITION.
- PLASTICS, RUBBER, COATINGS: MAY BE ATTACKED.
- POTASSIUM: POSSIBLE DANGEROUS REACTION.
- POTASSIUM HYDROXIDE + CHLOROFORM: EXOTHERMIC REACTION.
- POTASSIUM TERT-BUTOXIDE: FIRE AND EXPLOSION HAZARD.
- SODIUM + CHLOROFORM: POSSIBLE EXPLOSION.
- SODIUM HYPOCHLORITE: EXPLOSION HAZARD.
- SODIUM METHOXIDE + CHLOROFORM: VIOLENT REACTION.
- SULFURIC ACID: FIRE AND EXPLOSION HAZARD.
- ZINC: EXPLOSION HAZARD.

DECOMPOSITION:
THERMAL DECOMPOSITION PRODUCTS MAY INCLUDE TOXIC OXIDES OF CARBON.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

STORAGE AND DISPOSAL

OBSERVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN STORING OR DISPOSING OF THIS SUBSTANCE. FOR ASSISTANCE, CONTACT THE DISTRICT DIRECTOR OF THE ENVIRONMENTAL PROTECTION AGENCY.

STORAGE

STORE IN ACCORDANCE WITH 29 CFR 1910.106.

STORE AWAY FROM INCOMPATIBLE SUBSTANCES.

DISPOSAL

DISPOSAL MUST BE IN ACCORDANCE WITH STANDARDS APPLICABLE TO GENERATORS OF HAZARDOUS WASTE, 40 CFR 262. EPA HAZARDOUS WASTE NUMBER U154.

CONDITIONS TO AVOID

AVOID CONTACT WITH HEAT, SPARKS, FLAMES OR OTHER IGNITION SOURCES. VAPORS MAY

SOIL SPILL:
DIG HOLDING AREA SUCH AS LAGOON, POND OR PIT FOR CONTAINMENT.

DIKE FLOW OF SPILLED MATERIAL USING SOIL OR SANDBAGS OR FOAMED BARRIERS SUCH AS POLYURETHANE OR CONCRETE.

AIR SPILL:
APPLY WATER SPRAY TO KNOCK DOWN VAPORS.

WATER SPILL:
ALLOW SPILLED MATERIAL TO AERATE.

LIMIT SPILL MOTION AND DISPERSION WITH NATURAL BARRIERS OR OIL SPILL CONTROL BOOMS.

USE SUCTION HOSES TO REMOVE TRAPPED SPILL MATERIAL.

OCCUPATIONAL SPILL:
SHUT OFF IGNITION SOURCES. DO NOT TOUCH SPILLED MATERIAL. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. NO SMOKING, FLAMES OR FLARES IN HAZARD AREA! KEEP UNNECESSARY PEOPLE AWAY; ISOLATE HAZARD AREA AND DENY ENTRY.

REPORTABLE QUANTITY (RQ): 5000 POUNDS
THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) SECTION 304 REQUIRES THAT A RELEASE EQUAL TO OR GREATER THAN THE REPORTABLE QUANTITY FOR THIS SUBSTANCE BE IMMEDIATELY REPORTED TO THE LOCAL EMERGENCY PLANNING COMMITTEE AND THE STATE EMERGENCY RESPONSE COMMISSION (40 CFR 355.40). IF THE RELEASE OF THIS SUBSTANCE IS REPORTABLE UNDER CERCLA SECTION 103, THE NATIONAL RESPONSE CENTER MUST BE NOTIFIED IMMEDIATELY AT (800) 424-8802 OR (202) 426-2675 IN THE METROPOLITAN WASHINGTON, D.C. AREA (40 CFR 302.6).

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE GENERAL DILUTION VENTILATION TO MEET PUBLISHED EXPOSURE LIMITS. VENTILATION EQUIPMENT MUST BE EXPLOSION PROOF.

RESPIRATOR:
THE FOLLOWING RESPIRATORS AND MAXIMUM USE CONCENTRATIONS ARE RECOMMENDATIONS BY THE U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, NIOSH POCKET GUIDE TO CHEMICAL HAZARDS; NIOSH CRITERIA DOCUMENTS OR BY THE U.S. DEPARTMENT OF LABOR, 29 CFR 1910 SUBPART Z.
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND IN THE WORK PLACE, MUST NOT EXCEED THE WORKING LIMITS OF THE RESPIRATOR AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION (NIOSH-MSHA).

METHYL ALCOHOL (METHANOL):

2000 PPM- ANY SUPPLIED-AIR RESPIRATOR.
ANY SELF-CONTAINED BREATHING APPARATUS.

5000 PPM ANY SUPPLIED-AIR RESPIRATOR OPERATED IN A CONTINUOUS FLOW MODE.

10,000 PPM- ANY SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.
ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE.
ANY SUPPLIED-AIR RESPIRATOR WITH A TIGHT-FITTING FACEPIECE OPERATED IN A CONTINUOUS FLOW MODE.

25,000 PPM- ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE AND OPERATED IN A PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

ESCAPE- ANY APPROPRIATE ESCAPE-TYPE SELF-CONTAINED BREATHING APPARATUS.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

ANY SELF-CONTAINED BREATHING APPARATUS THAT HAS A FULL FACEPIECE AND IS OPERATED IN A PRESSURE-DEMAND OR OTHER POSITIVE-PRESSURE MODE.

ANY SUPPLIED-AIR RESPIRATOR THAT HAS A FULL FACEPIECE AND IS OPERATED IN A PRESSURE-DEMAND OR OTHER POSITIVE-PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE-PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONT[illegible] TH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH PROOF OR DUST-RESISTANT SAFETY GOGGLES TO PREVENT EYE CONTACT WITH THIS SUBSTANCE.

EMERGENCY EYE WASH: WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES MAY BE EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHOULD PROVIDE AN EYE WASH FOUNTAIN WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE

AUTHORIZED FISHER SCIENTIFIC, INC.

-ADDITIONAL INFORMATION-

Appendix D

Physical and Biological Hazard Information Sheets

PHYSICAL HAZARD INFORMATION SHEET:
UNDERGROUND UTILITIES

Underground utilities pose hazardous to workers involved in drilling, excavation, soil vapor contaminant analysis, and other invasive operations. These hazards include electrical hazards, explosion, and asphyxiation, as well as costly and annoying hazards associated with damaging communication, sewer, water, and/or irrigation lines.

The estimated location of underground installations, including sewer, telephone, fuel, electric, water lines, or other underground installations that reasonably may be expected to be encountered during invasive work shall be determined prior to the start of any invasive work. This may be determined by contacting appropriate utilities, contacting a utility clearance service, using site maps and prominent site features, using a pipe and cable locator, etc. Buried utilities encountered during invasive operations must be protected while digging to prevent risks to site personnel and damage to the utilities.

Site-Specific Hazards and Protective Measures: Drilling/trenching operations must be cleared prior to initiation.

PHYSICAL HAZARD INFORMATION SHEET: ELECTRICAL HAZARDS

Overhead power lines, electrical wiring, electrical equipment, and buried cables pose risks to workers of electric shock, burns, muscle twitches, heart fibrillation, and other physical injuries, as well as fire and explosion hazards. In accordance with OSHA's standard for Electrical Safety-Related Work Practices (29 CFR 1910.331-.335), protective measures must be taken when working near live electrical parts, including but not limited to:

- Insulation and guarding of life parts
- Grounding
- De-energizing live parts followed by lockout/tagout to prevent inadvertent reactivation of the parts
- Electric protective devices (e.g., insulated tools)
- Safe work practices, including:
  - Inspection of work area to identify potential spark sources
  - Maintenance of a safe distance from all live electrical parts
  - Proper illumination of work areas
  - No "blind reaching" around live electrical equipment
  - Provision of barriers, shields, or insulation to prevent inadvertent contact with live parts
  - Use of non-conductive, intrinsically safe equipment near live parts.

Overhead lines pose electrical hazards at many sites, particularly for work involving the use of equipment with elevated parts (e.g., drill rigs, backhoes). If overhead lines cannot be de-energized prior to the start of work, the following minimum distances must be maintained between the lines and both site workers and the longest conductive object present (including vehicles with elevated structural parts:

- 10 ft from overhead lines with voltage of 50 kV or less.
- 10 ft plus 4 in. for every 10 kV over 50 kV for overhead lines with voltages greater than 50 kV. For example, the minimum distance that must be maintained from a 250 kV line is 16.5 ft.

PHYSICAL HAZARD INFORMATION SHEET:
ELECTRICAL HAZARDS (Continued)

EA personnel are not permitted to work on electric parts of equipment that have not been de-energized, locked out, and tagged by personnel trained to work with electrical equipment. No EA employee may work near energized exposed live parts without the use of any protective measures. Personal protective equipment designed to protect against electrical hazards may be specified for certain work operations. The Project Manager is responsible for ensuring that appropriate safety measures are implemented to protect against electrical safety hazards on their sites.

Lightning is a hazard during outdoor operations, particularly for workers handling metal equipment. To eliminate this hazard, weather conditions should be monitored and work suspended at the discretion of the SHSO during electrical storms.

Site-Specific Hazards and Protective Measures:

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PHYSICAL HAZARD INFORMATION SHEET: DRUM HANDLING

PHYSICAL HAZARD AND INFORMATION SHEET: DRUM HANDLING

Specific safe work practices for drum handling are:

- No manual lifting or moving.
- No stacking drums on top of each other.
- Vehicle exhaust must have spark arrestors in the exclusion zone.
- No spark sources in the Exclusion Zone. The SSHO shall inspect for matches, lighters, battery operated equipment, sparking tools, and any other potential spark sources. All equipment must be rated intrinsically safe and hand tools must be non-sparking.
- Drums shall be opened, starting with the most downward drum and working upwind. This will reduce exposure hazards to the drum opener.
- If remote opening is not feasible, the drum opener shall stand behind a plexiglass shield that is at least 18 inches wide and 6 ft tall to prevent splashers to the worker. A wider shield is preferable, but it may be necessary to cut indentations for the arms. All other personnel must stand at least 20 ft upwind.
- When drum opening, allow time for possible venting as soon as the seal is broken. Do not remove the bung or lid until any excess internal pressure has been relieved. Place the bung or lid on plastic sheeting downwind of the drum.
- If any pressurized drums are discovered, use remote opening and, if possible, open the drum with out moving it. Instead, remove adjacent drums to create adequate space.
- Sample drums, starting with the downward drum. Use a sturdy step stool as needed to facilitate sample collection.
- When sampling acids and corrosives use the plastic shield.
- Exercise great caution during sampling to avoid spills. Sample the waste oil drums to develop good technique prior to sampling the more potentially hazardous liquids.
- Non-essential personnel must remain at least 20 ft upwind from drum sampling activities.
- Replace the bung or lid as soon as the samples are collected. This reduces emissions.

Site personnel should look constantly, closely, and carefully for these basic safety hazards and immediately inform the SSHO of any conditions that they feel may be hazardous.

PHYSICAL HAZARD INFORMATION SHEET:
HEAVY EQUIPMENT HAZARDS

The use of heavy equipment (e.g., backhoes, dump trucks, generators, compressors, etc.) may pose a variety of health and safety hazards to site workers.

All heavy equipment work must be conducted only by trained, experienced personnel. Equipment backing up, swinging loads, buckets, booms, and counter-weights pose serious hazards to ground personnel. If possible EA personnel must remain outside the turning radius of any large, moving equipment. At a minimum, EA personnel must maintain visual contact with the equipment operator when the equipment is active.

No EA personnel are permitted to work underneath heavy equipment, because this practice poses serious crushing hazards.

Belts, pulleys, sheaves, gears, chains, shafts, clutches, drums, flywheels, and other moving parts of equipment can pose injury hazards. No guard, safety appliance, or other device may be removed or made ineffective unless repairs or maintenance are required, and then only after power has been shut off and locked out. Safety devices must be replaced once repair/maintenance is complete.

Exhaust from all equipment powered by steam or combustion engines must be properly located so that release of exhaust does not endanger workers or obstruct the view of the operator. Gasoline-operated equipment must be re-fueled properly to prevent fire hazards; power must be off, no smoking allowed, and proper dispensing equipment must be used.

When not operational, equipment shall be set and locked so that it cannot be activated, released, dropped, etc. Backhoe buckets must be lowered to the ground.

Site-Specific Hazards and Protective Measures: ____________________________

PHYSICAL HAZARD INFORMATION SHEET: VEHICLE AND PEDESTRIAN TRAFFIC

ra at certain sites, particularly active sites in busy areas, presents a hazard to site rsonnel. Equipment must be located in an area that does not present hazards to standers. Barriers must be used to separate the work areas from both vehicle and destrian traffic areas and to prevent inadvertent entry of either type of traffic into the ork area. The demarcated area must include adequate buffer zones between the actual ork area and traffic areas. Standard traffic cones are not considered adequate for these uations, due to their low vertical profile. Taller, 28-in. cones can be effectively odified with warning flags and barricade tape. Safety pennants and plastic or steel "A" ame type barricades may also be used in high traffic areas. Flashing warning lights ay also be necessary. Barriers demarcating the work area and buffer zone are required en if the site is inactive during work operations.

nployees exposed to public vehicular traffic shall be provided with, and shall wear, arning vests or other suitable garments marked with or made of reflectorized or gh-visibility material.

excavation areas, excavated soil materials may be placed between the hole and traffic eas to act as a barrier to both vehicle and pedestrian traffic. Such material must be aced in a manner which will not pose engulfment hazards to either site workers or standers.

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PHYSICAL HAZARD INFORMATION SHEET: BIOLOGICAL HAZARDS

Insect Bites/Stings

Protective outer clothing such as gloves, hard hats, and coveralls can help reduce the potential for insect bites and stings. Insect bite symptoms include redness, rash, swelling, chills, fever, diarrhea, and vomiting. Any worker who has been bit or stung and shows symptoms of a severe reaction should seek medical assistance immediately. Workers who know of any allergies they may have to any insects must advise their employer prior to engaging in any field activities and may want to carry antidote kits.

To prevent contact with disease-carrying ticks, wear long-sleeved shirts, long pants, and boots that extend above the ankle with socks pulled over pants cuffs. Permanone insecticide may be used to kill disease-bearing ticks and may be sprayed only on the outside of clothing (<u>not</u> directly on skin). Frequently check clothing, skin, and hair for the presence of ticks at the end of the work day. If a tick attaches to the body, remove by gently tugging with tweezers where the mouth parts enter the skin. Do not kill the tick prior to removal.

Poisonous Plants

Poisonous plants such as poison ivy may be present on certain sites during part of the year. Know how to recognize these plants and avoid contact. If contact occurs, wash affected areas with soap and water immediately.

Snakes/Rodents

On occasion, field workers may come into contact with snakes and/or rodents (rats, gophers, etc.). In case of a snake bite, which can be fatal, workers must immediately seek medical assistance and report the incident to the SSHS and Site Manager, according to the procedures delineated in the SHERP. Prompt medical attention is also required for rodent bites since many rodents carry rabies and other diseases. Field workers must report rodent bites to the SSHS and Site Manager immediately according to SHERP requirements.

Site-Specific Hazards and Protective Measures: Biological hazards are expected to be minimal due to the time of the year for most of the planned activities. However, workers should keep as much skin as possible covered to protect against bites, stings, etc.

PHYSICAL HAZARD INFORMATION SHEET:
GENERAL PHYSICAL HAZARDS

Hazardous waste and other field operation sites include many basic safety hazards, such as:

- Holes, ditches, etc., posing fall, cave-in, and other hazards
- Precariously positioned objects, which may cause crushing or other injuries
- Sharp objects (e.g., nails, metal shards, glass), which may cause cuts, injection, or other injuries
- Slippery surfaces, posing slip and fall hazards
- Steep grades and/or uneven terrain, posing slip, trip, and fall hazards
- Unstable surfaces (e.g., walls that may cave-in, unstable underground structures) which may pose fall, crushing, or other injuries.

Basic safety hazards can directly injure workers and create additional hazards. For example, a person may trip due to uneven terrain, fall and be cut on rusty metal shards, and become inoculated with contaminants adhering to the metal.

Site personnel should look constantly, closely, and carefully for these basic safety hazards and immediately inform the SSHO of any conditions that they feel may be hazardous.

PHYSICAL HAZARD INFORMATION SHEET: DRILLING

The selection of locations for each drilling activity site will take into account buried utility pipes, wires, conduits, and tanks, or other potentially dangerous structures. Overhead power lines and obstructions will also be surveyed. Prior to raising the mast, the area overhead and surrounding the rig will be checked by the drilling foreman and the SSHO. The longest conductive object on the drill rig will be located with a minimum of 10-ft clearance from overhead lines with voltages less than or equal to 50 kV. For lines with voltages exceeding 50 kV, the longest drill rig object must be at least 10 ft plus 4 in. for every 10 kV over 50 kV (e.g., for 250 kV line, clearance must be at least 16.7 ft). The client will inform EA of the voltages of any overhead lines in the vicinity of drilling operations.

When rotary drilling/sampling, drill rods will not be racked more than 1.5 times the height of the mast. During drilling operations and rig setup and takedown, all persons who enter the Exclusion Zone will wear hard hats, safety shoes/boots, and safety glasses/face shields to protect personnel from the physical hazards.

If during drilling there is any indication that underground tanks, drums, or other containers are being encountered, the drilling will be halted immediately and the SSHO shall notify the Program Safety and Health Officer. Indications that a waste container may have been encountered include: (1) change in the speed or momentum of the auger, (2) visual examination of auger cuttings, (3) odor noted in the cuttings, and/or (4) the presence of airborne total volatile organics as measured with a direct-reading instrument.

Work around drilling equipment also involves basic safety hazards (e.g., snapping cables, slings, ropes, moving heavy equipment, slip and trip hazards, etc.). Accidents may include head injuries from falling tools and equipment, hand and feet injuries due to moving equipment, and crushing injuries from unstable equipment or careless moving of equipment. If possible, EA personnel must remain outside the turning radius of any large moving equipment. If this is not feasible then, at a minimum, EA personnel must maintain visual contact with the equipment operator at all times when equipment is active.

PHYSICAL HAZARD INFORMATION SHEET: FIRE/EXPLOSION HAZARDS

Explosion and fire hazards may be present at various sites due to ignition of chemicals, agitation of shock-sensitive compounds, the sudden release of materials under pressure, etc. All site operations must be conducted in accordance with local fire codes and regulations. Continuous monitoring for combustible gases is required at sites where such gases may be present during spark-generating operations. Fire extinguishers and other fire-fighting provisions may also be necessary. Site personnel must be trained in the use of such fire-fighting equipment prior to the start of work operations. Site-specific requirements for monitoring and fire emergency equipment must be specified in the SHERP.

Site-Specific Hazards and Protective Measures:

PHYSICAL HAZARD INFORMATION SHEET
NOISE HAZARDS

Work around large equipment often creates excessive noise. The effects of noise can include:

- Workers being startled, annoyed, or distracted
- Physical damage to the ear, pain, and temporary and/or permanent hearing loss
- Communication interference that may increase potential hazards due to the inability to warn of danger and provide for proper safety precautions to be taken.

If workers are subjected to noise exceeding an 8-hour time-weighted average sound level of 85 decibels on the A-weighted scale (dBA), feasible administrative or engineering controls shall be instituted to reduce noise levels to or below the permissible values. All personnel exposed to excessive noise levels shall be provided with and shall wear a hearing protection device which effectively protects the workers. OSHA regulations on noise can be found in 29 CFR Part 1910.95.

Site-Specific Hazards and Protective Measures:

PHYSICAL HAZARD INFORMATION SHEET:
MATERIAL HANDLING/MOVING/LIFTING

Improper materials handling accounts for a large number of occupational injuries. Materials handling at hazardous waste sites can vary from heavy equipment handling to manually handling items. Hazards associated with materials handling include physical injury, detonation, fire, explosion, and vapor generation.

When using equipment to move materials, proper work practices must be followed. Equipment used must be designed for the task to be performed. Equipment must be inspected regularly by the SSHO and the Site Manager, and damaged or defective equipment must be removed from service. Planning is critical when handling materials. The Site Manager, in conjunction with the CTO Manager, must plan where the materials are to be moved, taking into consideration the current location of such materials and hazards associated with moving them. Routes for moving materials must be clearly outlined, with paths cleaned of all obstructions so materials may be transported.

Injuries to the back and abdominal muscles from improper lifting of loads is one of the most common occupational injuries reported. Such injuries can range from relatively mild strains to major permanently disabling injuries. Before lifting any load, personnel should consider the overall weight, distribution of weight, unwieldiness or awkwardness of the load, distance to be carried, obstacles to be negotiated, site conditions, and visibility. Loads should be inspected for slivers, sharp edges, slippery surfaces, etc. prior to lifting.

Loads should be lifted using the power of the leg muscles rather than the back, stomach, or arm muscles. Approach the item to balance the load evenly. Never bend over when lifting. The back should be kept straight and the arms nearly parallel with the body. The knees should be bent to grasp the load. Lifting should be done by straightening the legs, holding the load as close to the body as possible, and the back remaining as straight as possible.

Bulky, heavy loads should be handled by at least two people, ensuring that the load is level and evenly distributed between all personnel helping to carry it. All carriers should know the destination and path for the load.

Site-Specific Hazards and Protective Measures: ______________________________

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HYSICAL HAZARD INFORMATION SHEET: COLD STRESS

ɔld stress hazards are most likely to occur at low temperatures or low wind chill c with wet, windy conditions also contributing to risks. All personnel should be miliar with cold stress symptoms, which include:

Hypothermia: Cold-induced decreasing of the core body temperature that produces shivering, numbness, drowsiness, and muscular weakness. If severe enough, it can lead to unconsciousness and death.

Frostbite: Constriction of blood vessels in the extremities, decreasing the supply of warming blood. May result in formation of ice crystals in the tissues, causing tissue damage. Condition may range from frostnip which is a numbing of extremities, to deep-freezing tissue beneath the skin. Symptoms include white or grayish skin, blisters, numbness, mental confusion, failing eyesight, fainting, shock, and cessation of breathing. Death may occur from heart failure.

in in the extremities may be the first warning of cold stress, and precautions (see low) should be taken to reduce exposure. Maximum severe shivering must be taken as ign of immediate danger to the worker, and exposure to cold must be immediately minated. Personnel exhibiting signs and symptoms of cold stress must be removed m the site, decontaminated, and given appropriate first aid. Emergency medical vices must be contacted if symptoms are severe (e.g., more than numbness of the remities or shivering). When air temperatures are less than 36° F (including wind ill), workers who become immersed in water or whose clothing becomes wet must be n tely provided a change of clothing and be treated for hypothermia.

prevent cold stress when air temperature is less than 40°F (including wind chill), sonnel should wear layers of loose-fitting clothing including insulated coveralls, head ering, and boots. Protection of the hands, feet, and head is particularly important ause these are likely to be injured first by cold. However, actual injury to hands, t, and head is not likely to occur without prior development of early signs of othermia such as numbing and shivering. Bare skin contact with cold surfaces (below 'F) must be avoided. Personnel should wear wind-resistant outer shell to decrease d chill effects. No continuous exposure to cold is permitted when the air speed and perature results in an equivalent chill temperature of 26°F or less.

emperature-dependent work regimen limiting lengthy periods of outdoor activity may necessary. Workers entering heated shelters should remove the outer layer of clothing loosen remaining clothing to permit sweat evaporation. Dehydration must be avoided drinking warm drinks or soups.

-Specific Hazards and Protective Measures: ______________________________

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PHYSICAL HAZARD INFORMATION SHEET: HEAT STRESS

'ersonnel working under high-temperature conditions or wearing protective clothing while working in warm temperatures are subject to heat stress. Symptoms of heat stress may iclude:

Heat Cramps:
Muscle spasms in the abdomen or limbs. Frequent rest periods and fluid intake are appropriate measures to prevent or reduce heat cramps.

Heat Exhaustion:
Severe dehydration; pale, clammy skin; profuse sweating; dizziness, light-headedness; slurred speech; rapid pulse; confusion; fainting; fatigue; cool skin; nausea. Affected personnel should be escorted from the site, decontaminated promptly, set in cool, shaded area, and given fluids slowly.

Heat Stroke:
Life-threatening condition occurring when the body's temperature-regulating system improperly functions. Hot dry skin; rapid, deep breathing; lack of perspiration; delirium; high fever (often 106°F or more), nausea; unconsciousness. Brain damage and/or death may occur, if body temperature is not reduced. Provide fluids, use cooling devices (hose-down or shower), call emergency medical services or transport to hospital immediately.

event heat stress by resting frequently in a shaded area and consuming large quantities of esh potable water (<u>more</u> than amount needed to simply "quench thirst"). Drink at least 8 of water or Gatorade every 2 hours when temperatures exceed 75°F.

heat stress symptoms are wide-spread among workers or observed frequently, the SSHS ould implement an appropriate work-rest period so that after 1 minute of rest, a person's art rate (HR) does not exceed 110 beats per minute (bpm) based on pulse. If the HR ceeds 110 bpm, the next work period should be shortened by 33 percent, while the length the rest period remains the same. If the HR is 110 bpm at the beginning of the next rest riod, the following work cycle should be reduced by 33 percent. A healthy individual's ting HR is usually 60-72 bpm.

e-Specific Hazards and Protective Measures: ______________________________

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Appendix E

Site Safety and Health Activity Report

ATTACHMENT E

SITE SAFETY AND HEALTH ACTIVITY REPORT

SITE: Naval Construction Battalion Center, Davisville CTO NO.: 0032		Project No. 29600.32
Weather Cond.:		Onsite Hours: From To
Changes in PPE Levels[a]	Work Operations	Reasons for Change
Site Safety and Health Plan Violations	Corrective Action Specified	Corrective Action Taken (yes/no)
Observations and Comments:		
Completed by: ______________________ Site Safety and Health Officer		Date
(a) Only SSHO may change PPE levels, using only criteria specified in SHERP.		

Appendix F

Environmental Monitoring Record

APPENDIX F

ENVIRONMENTAL MONITORING RECORD

SITE: Naval Construction Battalion Center, Davisville — Project No. 29600.32
CTO NO.: 0032

INSTRUMENT: ______________________________

CALIBRATION: Gas: __________ Conc: ________ Span: ________

Time	Monitoring Location	Reading	Corrective Action Taken[a]

Comments:

(a) Corrective actions taken must be documented whenever readings at or above action levels are reached.

Recorded By: ____
Site Safety and Health Officer — Date

Appendix G

Monitoring Instrument Calibration Procedures

STARTUP AND CALIBRATION PROCEDURE FOR THE HNu PHOTOIONIZATION DETECTOR, MODELS HW-101 AND PI-101

STARTUP

1. Connect the probe to the readout assembly, making sure that the red interlock switch is depressed by the ring on the connector.

2. Turn the function switch to BATT. The needle should move to green region. If not, the battery needs to be recharged.

3. Zero Set--Turn the function switch to STANDBY. Allow the instrument to warm up at least 1 minute. Set the zero point with the ZERO set control.

CALIBRATION

1. Fill <u>empty</u> Tedlar bag with 100 ppm isobutylene gas standard (used to calibrate HNU to <u>55</u> ppm). Attach probe to Tedlar bag. <u>Do</u> <u>not</u> connect HNU probe directly to isobutylene tank.

2. Turn the Function Switch to the 0-200 range position and note the meter reading. If meter does not read 55 ppm, use the SPAN Control Knob to set the meter reading at 55 ppm. Lock the SPAN Control Knob.

3. Record identity and concentration of calibration gas and the SPAN Control setting on the Environmental Monitoring Record <u>each</u> time the instrument is calibrated.

4. Re-calibrate the HNU each time the instrument is turned off. Place the instrument on STANDBY when not in active use during the work day.

CAUTION: Check the battery charger frequently throughout the work period--<u>do</u> <u>not</u> allow the needle to fall below the green line when the function switch is on BATT. If needles approach the left range of this green line, stop and recharge the instrument.

Probe must be attached to the readout assembly, with the interlock switch fully depressed, in order to recharge the instrument.

STARTUP AND CALIBRATION PROCEDURE FOR MODELS OVA-128 AND 128-GC CENTURY ORGANIC VAPOR ANALYZER

STARTUP

1. Connect the probe/readout assembly to the Sidepack Assembly by attaching both the sample line and the electronic jack.

2. Move the Instr/Batt Switch to the BATT position and check that readout needle moves beyond the white "batt check" line.

3. Move the Instr/Batt Switch to the "On" position and warm up <u>at least</u> 5 minutes.

4. Turn the Pump Switch on, set Sidepack Assembly in upright vertical position, and make sure that sample flow rate is approximately 1.5-2.5 units. If less, check filters.

5. Set CALIBRATE Switch to the X1 position, and use CALIBRATE knob to set meter to read 0.

6. Open the HYDROGEN TANK VALVE one or two turns. [Hydrogen Tank pressure should read at least 1,500 psi if 8-hour supply is desired. Otherwise, shut down instrument and fill tank with hydrogen.] Open HYDROGEN SUPPLY VALVE one or two turns. Hydrogen Supply Pressure Indicator should read between 8 and 12 psi.

7. Wait approximately 1 minute, then depress IGNITER Button until hydrogen flame lights (meter needle will jump upscale and faint "pop" may be heard if flame ignites). <u>Do not depress</u> igniter more than 6 seconds. If flame does not light, wait 1 minute and tray to re-ignite.

8. Use CALIBRATE know to "zero" out background by setting CALIBRATE Switch to X1 and reading zero on meter. To avoid false flame out alarm, set meter to 1 ppm with CALIBRATE knob and make differential readings.

CALIBRATION

1. Fill <u>empty</u> Tedlar bag with 100 ppm methane gas standard.

2. Use Tygon Tubing to connect bag to probe on OVA Readout Assembly. <u>Never connect</u> the OVA directly to methane gas tank.

3. Set CALIBRATE Switch to X10 and read meter. If meter does not read 100 ppm, use the GAS SELECT KNOB to set the readout meter to correspond to 100 ppm. Lock the GAS SELECT KNOB.

4. RECORD identity of calibration gas, concentration, and GAS SELECT reading on Environmental Monitoring Record each time instrument is calibrated.

START-UP AND CALIBRATION PROCEDURE FOR
MODEL HX-251 INDUSTRIAL SCIENTIFIC
CGI/O_2 METER

START-UP:

1. Ensure that batteries for both the meter and pump (if to be used with meter) have been fully charged (at least overnight).

2. Turn screw on bottom of meter and rotate metal plate 180 degrees. Tighten screw. Alarm should sound briefly and digital readout should appear.

3. Depress OX switch and ensure that meter reads 20-21 percent. If necessary, loosen metal plate and use small screwdriver to adjust the OX screw until desired oxygen reading appears.

4. Depress LEL Switch and ensure that meter reads 0. If necessary, loosen metal plate and use small screwdriver to adjust the ZERO screw until meter reads 0.

CALIBRATION:

1. If oxygen reading in Step 3 was taken in normal ambient environment, no further calibration of the oxygen meter is needed.

. Fill Tedlar bag with calibration gas standard (must be in percent concentrations - calibration gas tank label should indicate percent LEL of calibration gas).

3. If meter is to be used in passive mode (i.e. no sampling pump), attach calibration cup to top of meter and attach to Tedlar bag using Tygon tubing. If sampling pump is to be used, attach pump to meter and attach filled Tedlar bag to pump inlet.

4. Depress LEL Switch and note the meter reading. If necessary, adjust the small LEL screw underneath the metal plate as required to make meter reading correspond with calibration gas concentration.

5. Record identity of calibration gas, concentration and calibration date on the Environmental Monitoring Record each time the instrument is calibrated.

Appendix H

Site Entry and Exit Log

APPENDIX H

SITE ENTRY AND EXIT LOG

Date	Name	Representing	Time	
			In	Out

Appendix I

Emergency Information

APPENDIX I

EMERGENCY INFORMATION

SITE: Naval Construction Battalion Center, Davisville — Project No. 29600.32
CTO NO.: 0032

Nearest telephone (give location, directions, and telephone number): Building No. 404, East of the intersection of Davisville Rd and Route 1.

Other site communication equipment:

Name		Phone Number
Police:	8166 Post Road, N. Kingstown	(401) 294-3311
Fire:	8150 Post Road, N. Kingstown	(401) 294-3344
Ambulance:	8150 Post Road, N. Kingstown	(401) 294-3344
Hospital:	Kent County Memorial Hospital, 445 Toll Gate Road, Warwick	(401) 737-7000
Security:	Sergeant of the Guard	(401) 267-2541

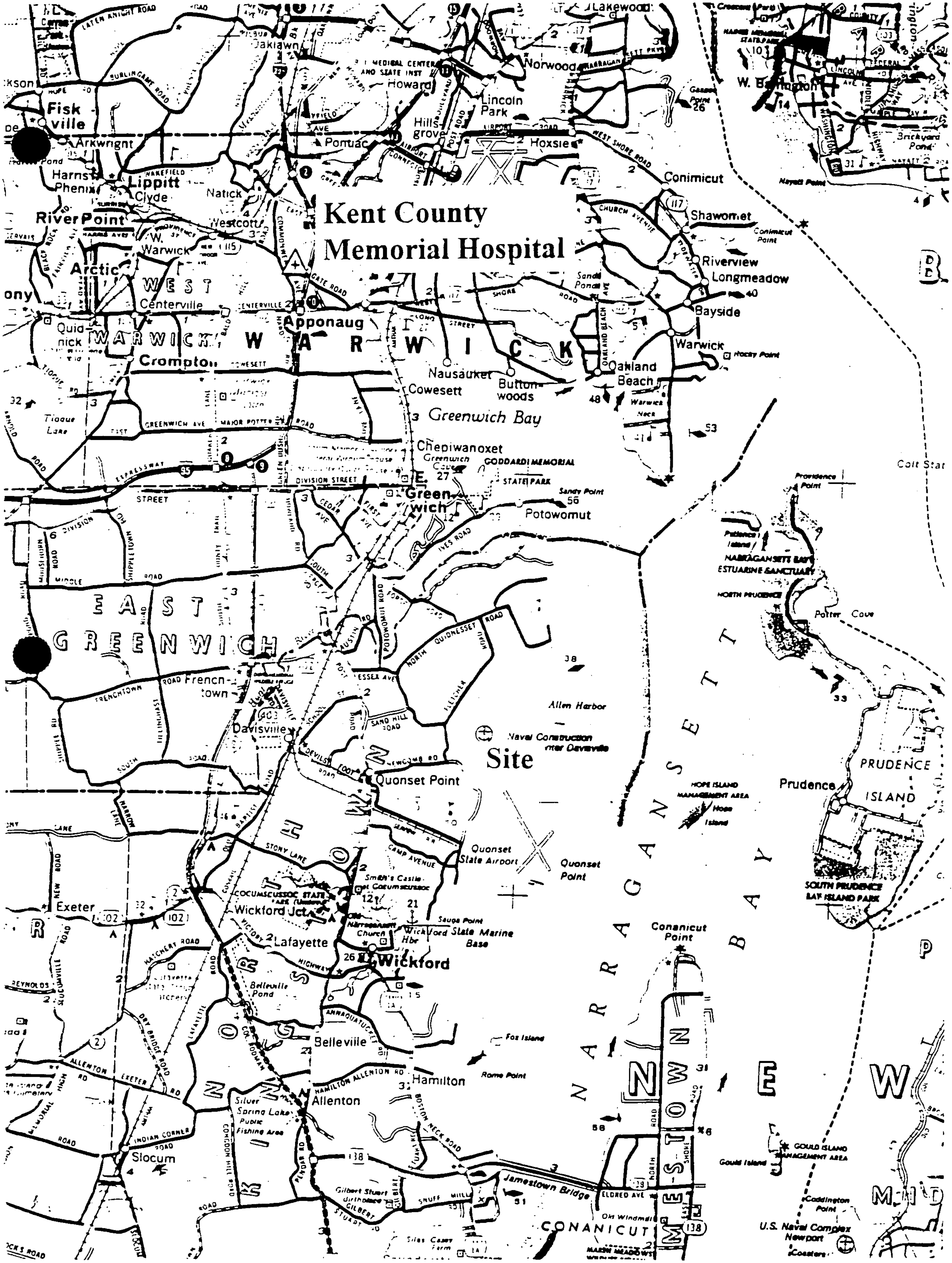
Directions to Hospital: Exit NCBC Davisville by traveling west on Davisville Road. Proceed to entrance of NCBC Davisville. Proceed under Route 2 overpass onto Devil's Food Road. Continue approximately 2 miles on Devil's Food Road and turn right onto Route 4 North. Take Route 4 North to Route 95 North. Take the first exit off of Route 95 onto Route 117. Take a left onto Route 117. Proceed one block to a traffic light and turn right. Follow road and bear right at first intersection. Follow road to the end and take a left onto Toll Gate Road. Hospital will be on your right.

NATIONAL RESPONSE CENTER: **1-800-424-8802**

NAVFAC Technical Manager

CTO Manager: Nick Lanney	(617) 784-1767
Site Manager: George Lukert	(617) 784-1767
Site Safety and Health Officer: Susan Braun	(617) 784-1767
Program Manager Charles Houlik, Ph.D., CPG	(410) 771-4950 (work)
Deputy Program Manager Sam Morekas	(410) 771-4950 (work)
Program Safety and Health Officer Kris Hoiem, CIH	(410) 771-4950 (work) (410) 357-5485 (home)
EA Corporate Safety and Health Officer Clayton Bock	(410) 584-7000 (work)
EA Medical Services Medical College Hospital, Bucks County Campus Warminister General Hospital 225 Newtown Road Warminister, Pennsylvania 18974	(215) 441-6600
Poison Control Center	(800) 822-9761
In case of accident or exposure, contact the EA Human Resources representative within 24 hours: Toni Sircely	(410) 584-7000

NOTE: The CTO manager will verify telephone numbers and check with the emergency responder to ensure coordination. The medical facility will be contacted to determine the ability and desire to treat potentially contaminated patients.



Kent County
Memorial Hospital
Site
Fiskville
Arkwright
Harris
Phenix
Lippitt
Clyde
River Point
Natick
Westcott
W. Warwick
Arctic
WEST
Centerville
Quidnick
WARWICK
Crompton
Apponaug
Oaklawn
Howard
Pontiac
Hillsgrove
Lincoln Park
Norwood
Hoxsie
Lakewood
Conimicut
Shawomet
Riverview
Longmeadow
Bayside
Warwick
Oakland Beach
Nausauket
Buttonwoods
Cowesett
Greenwich Bay
Chepiwanoxet
Greenwich Cove
GODDARD MEMORIAL STATE PARK
Sandy Point
Potowomut
E. Greenwich
EAST GREENWICH
Frenchtown
Davisville
Naval Construction Center Davisville
Allen Harbor
Quonset Point
Quonset State Airport
Exeter
Wickford Jct.
Lafayette
Wickford
Belleville
Hamilton
Allenton
Slocum
Tioque Lake
Silver Spring Lake
Rome Point
Fox Island
Jamestown Bridge
CONANICUT
Conanicut Point
NARRAGANSETT BAY
JAMESTOWN
NEWPORT
Hope Island
PRUDENCE ISLAND
Prudence
Potter Cove
NARRAGANSETT BAY ESTUARINE SANCTUARY
SOUTH PRUDENCE BAY ISLAND PARK
Gould Island
U.S. Naval Complex Newport
W. Barrington
Colt State

Appendix J

Accident Investigation Report

ACCIDENT INVESTIGATION REPORT

CASE NUMBER

COMPANY ______________________ ADDRESS ______________________

DEPARTMENT ______________________ LOCATION (if different from mailing address) ______________________

1. NAME of INJURED
2. SOCIAL SECURITY NUMBER
3. SEX ☐ M ☐ F
4. AGE
5. DATE of ACCIDENT

6. HOME ADDRESS
7. EMPLOYEE'S USUAL OCCUPATION
8. OCCUPATION at TIME of ACCIDENT

9. LENGTH of EMPLOYMENT
☐ Less than 1 mo. ☐ 6 mos. to 5 yrs.
☐ 1-5 mos. ☐ More than 5 yrs.

10. TIME in OCCUP. at TIME of ACCIDENT
☐ Less than 1 mo. ☐ 6 mos. to 5 yrs.
☐ 1-5 mos. ☐ More than 5 yrs.

11. EMPLOYMENT CATEGORY
☐ Regular, full-time ☐ Temporary ☐ Nonemployee
☐ Regular, part-time ☐ Seasonal

12. CASE NUMBERS and NAMES of OTHERS INJURED in SAME ACCIDENT

13. NATURE of INJURY and PART of BODY

14. NAME and ADDRESS of PHYSICIAN

15. NAME and ADDRESS of HOSPITAL

16. TIME of INJURY
A. ________ A.M. / P.M.
B. Time within shift
C. Type of shift

17. SEVERITY of INJURY
☐ Fatality
☐ Lost workdays—days away from work
☐ Lost workdays—days of restricted activity
☐ Medical treatment
☐ First aid
☐ Other, specify ______________

18. SPECIFIC LOCATION of ACCIDENT

ON EMPLOYER'S PREMISES? ☐ Yes ☐ No

19. PHASE OF EMPLOYEE'S WORKDAY at TIME of INJURY
☐ During rest period ☐ Entering or leaving plant
☐ During meal period ☐ Performing work duties
☐ Working overtime ☐ Other ______________

20. DESCRIBE HOW the ACCIDENT OCCURRED

21. ACCIDENT SEQUENCE. Describe in reverse order of occurrence events preceding the injury and accident. Starting with the injury and moving backward in time, reconstruct the sequence of events that led to the injury.

A. Injury Event ______________________

B. Accident Event ______________________

C. Preceding Event #1 ______________________

D. Preceding Event #2, #3, etc. ______________________

22. TASK and ACTIVITY at TIME of ACCIDENT

A. General type of task ______________________

B. Specific activity ______________________

C. Employee was working:

☐ Alone ☐ With crew or fellow worker ☐ Other, specify ______________

23. POSTURE of EMPLOYEE

____

24. SUPERVISION at TIME of ACCIDENT

☐ Directly supervised ☐ Not supervised

☐ Indirectly supervised ☐ Supervision not feasible

25. CAUSAL FACTORS. Events and conditions that contributed to the accident. Include those identified by use of the Guide for Identifying Causal Factors and Corrective Actions.

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26. CORRECTIVE ACTIONS. Those that have been, or will be, taken to prevent recurrence. Include those identified by use of the Guide for Identifying Causal Factors and Corrective Actions.

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PREPARED BY ______________________

____

DEPARTMENT ______________________ DATE ______________

APPROVED ______________________

TITLE ______________ DATE ______________

APPROVED ______________________

TITLE ______________ DATE ______________

Developed by the National Safety Council

APPENDIX B

FIELD SAMPLING PROCEDURES
for SUBSURFACE INVESTIGATIONS

PHASE III PROGRAM REMEDIAL INVESTIGATION WORK PLAN
INSTALLATION RESTORATION SITES 03 AND 09
NAVAL CONSTRUCTION BATTALION CENTER
DAVISVILLE, RHODE ISLAND

Contract No. N62472-92-D-1296
Contract Task Order No. 0032

Prepared for

Department of the Navy
Northern Division
Naval Facilities Engineering Command
10 Industrial Highway
Mail Stop No. 82
Lester, Pennsylvania 19113-2090

Prepared by

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2 Commercial Street
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October 1994
DRAFT
EA PROJECT 296.0032

TABLE OF CONTENTS

APPENDIX B

Table of Contents (Continued)

Table of Contents (Continued)

FIELD SAMPLING PROCEDURES

This appendix presents the subsurface investigation procedures for the drilling of borings, the installation of monitoring wells; and the collection and handling of soil, bedrock core, and ground-water samples. This appendix also outlines equipment decontamination and investigative waste handling procedures.

1. DRILLING PROCEDURES

This section presents the procedures for drilling activities, borehole logging, and borehole backfilling. The drilling activity will be performed using the following guidelines:

- Obtain Base approval for boring locations.
- Obtain all Base, Rhode Island Port Authority (RIPA), and Digsafe (800-225-4977) clearances for boring locations.
- Mitigate contamination of the aquifer by the drilling equipment.
- Mitigate inter-aquifer contamination.
- Following installation of the monitoring wells, mitigate vertical seepage of surface water runoff into the monitoring well opening and contact points with ground surface.

1.1 Drilling Location Clearance

Digsafe and RIPA clearance will be obtained prior to any drilling activities. Both Base and RIPA personnel will locate and mark all underground utilities in the vicinity of the Site prior to any drilling or digging. EA will obtain any required drilling or digging permits necessary for completion of the field work at the Site. This clearance will be coordinated by the EA CTO Project Manager.

1.2 Drilling Procedures

Borings will be performed to obtain subsurface soil and rock samples and allow for the installation of each monitoring well. The following five monitoring wells are planned for installation at Site 09: 09-MW-14 and 09-MW-15 to be screened in the lower portion of the upper aquifer, 09-MW-16 to be screened in the silt unit, and 09-MW-17 and 09-MW-18 to be screened in the bedrock. Four wells to be screened at the bottom of the unconsolidated material are planned at Site 03.

1.2.1 Soil Boring

The soil borings/monitoring wells will be advanced using 4.25-in. inside diameter (ID) hollow stem augers with a center hole plug except for 09-MW-16. Well 09-MW-16 (to be screened in the silt unit) will be drilled using a combination of methods to mitigate cross contamination of geological units/aquifers. The hollow-stem auger method will be used through the landfill material and into the native geological material to a total depth of 15 feet below grade. Then, 4-inch diameter steel casing with a drive shoe will be placed through the augers. The casing will be driven and drilled out via the rotary wash method to the top of each split spoon sample interval (refer to Section 1.4.2, Site 09, regarding sample frequency). The driving and drilling will continue until the bottom of the steel casing is 5-10 ft below the upper surface of the silt unit. The inside of the casing then will be flushed with water from the acceptable source (Section 1.3) to remove potentially contaminated drilling fluids. Samples of the water discharged from the casing will be collected in clean glass jars, and then, headspace vapor measured with a PID by following the procedures presented for soil samples in Section 3.1.1. The flushing will continue until the measurements of 3 consecutive samples are less than 2 PID units. Rotary wash drilling with new drilling fluid will then continue beyond the bottom of the steel casing to the top of bedrock with split spoon sampling of soil at the frequency presented in Section 1.4.2. For 09-MW-17 and)09-MW-18, refer to Section 1.2.3 (Rock Coring) for the drilling method to complete the borehole.

Drill (soil) cuttings and mud will be containerized and handled in accordance with the procedures in Section 7.2. The vapor in the area above the borehole will be monitored with a photoionization detector (PID) equipped vapor analyzer with 11.7 ev probe (e.g., a Photovac MicroTip or similar). The PID will be calibrated each work day before work begins, before the beginning of the afternoon drilling, at the end of the day, and as required in the field.

Drilling and sampling equipment including drill pipe, sampling tools, and auger flights will be free of potentially contaminating materials and will be steam cleaned prior to use at each well/boring as stated in Section 7.1.2. The drill rig will be steam cleaned prior to use at NCBC - Davisville and as required by the EA field geologist. The rig will be free of leaks which could potentially contaminate the borings. No grease will be used on drill pipe joints.

1.2.2 Rock Coring

At Site 09, the bedrock borings will extend through the gray silt unit. Hollow stem augers will be used to drill to the base of the silt unit. However, if evidence of high concentrations of VOC, such as elevated soil headspace screening results or solvent odors, is found when drilling 09-MW-17 or 09-MW-18 (wells to be screened in bedrock), the field team leader will stop drilling activities, and notify the CTO Manager. The CTO Manager will evaluate the situation to determine if the boring should continue to be advanced using hollow stem augers or 4-in. casing and rotary wash techniques, as is proposed for 09-MW-16.

The rock coring method will be used to drill approximately 20 - 30 ft into bedrock. The primary objective of rock core sampling is to obtain a continuous sample of the intact rock mass to allow visual evaluation of the geologic and hydrogeologic properties of the rock. In addition to collection of rock samples, the completed rock-core borehole will be used to conduct packer testing (Section 2.6) and install a monitoring well to permit the collection of ground-water samples.

For rock coring at Site 09, a double-tube core barrel with either a rigid- or a swivel-type inner tube will be used. The rigid-type inner tube will be fixed rigidly to the core barrel head so that it rotates with the outer tube. The swivel-type inner tube will be supported on a ball-bearing carrier which allows the inner tube to remain stationary (or nearly so) during rotation of the outer barrel. The sample or core is cut by rotation of the diamond bit (NX size = 2.980 O.D.).

The swivel-type, double-tube core barrel will have either an inner solid or split-tube. Depending on the quality of the rock being cored, the inner tube may be alternately used. The solid tube will be used primarily in very sound and competent portions of the rock, while the split tube will be used in the weaker and more weathered portions. All coring equipment will be steam cleaned prior to use at each boring location as stated in Section 7.1.2.

Drilling and sampling equipment including drill pipe and sampling tools will be free of potentially contaminating materials and will be steam cleaned prior to use at each well/boring as stated in Section 7.1.2. A centralized staging and decontamination area will be established at the Activity. The staging area will have access to portable water and be large enough to store drilling and sampling equipment. Decontamination procedures are presented in Section 7.1.2.

1.3 Water Source

Water for drilling, steam cleaning, and other necessary field activities will be arranged by NCBC - Davisville. The boring contractor will be responsible for obtaining and transporting all water to the drilling areas for required uses. EA will sample the water at each source and test it for the same parameters specified for ground-water samples in Chapter 3.3 of the Work Plan. This information and documentation of the source of the water (i.e., fire hydrant location, etc.) will be is used to evaluate the potential impact the water source may have on the analytical results for samples collected from the planned borings/wells.

1.4 Split-Spoon Sampling

Soil sampling will be performed using a stainless-steel, split-spoon sampler measuring 1-3/8 in. ID, 2 in. OD, and 24 in. in length. The sampler will be inserted into the borehole to the top of undisturbed material, and then driven a total of 24 in. using a 140-lb hammer falling a distance of 30 in.

1.4.1 Site 03

Split-spoon sampling of the soil will be performed every 5 ft to the bottom of the boring (bedrock). The soil samples will be used for general stratigraphic identification, headspace vapor analysis (Section 3.1.1), field GC analysis (Section 3.1.2), and chemical analysis (Section 3.1.3). Prior to each use, the sampler will be decontaminated as presented in Section 7.1.2.

1.4.2 Site 09

For the two shallow monitoring well borings, split-spoon sampling of the soil will be performed every 5 ft to a depth of 20 ft, and then, continuously to about 5 ft into the silt unit. The boring for the monitoring well to be installed in the silt unit will be sampled in the same manner as the shallow wells, then continue at 5-ft intervals to the top of bedrock. The soil portion of the borings for wells to be completed in bedrock will be sampled at 5-ft intervals to the top of bedrock. The soil samples will be used for general stratigraphic identification, headspace vapor analysis (Section 3.1.1), and chemical analysis (Section 3.1.3). Prior to each use, the sampler will be decontaminated as presented in Section 7.1.2.

1.5 Borehole Logging

The boring (drilling) activities will be observed by an EA Geologist or Geotechnical Engineer. The Geologist/Engineer will log the subsurface conditions encountered in the boring and record the information on a soil boring and rock core log as appropriate.

1.5.1 Borehole Logging Requirements (Soil)

Soil samples will be visually classified in the field using the Unified Soil Classification System. An example of a soil boring log is shown in Figure B-1. Borehole logging requirements will include, as a minimum:

1. Logs will be prepared in the field, as borings are drilled, by an EA Geologist or Geotechnical Engineer. Each log will be signed and dated by the preparer, and QC checked in the office by a Senior Geologist.

2. Borehole depth information will be direct measurements accurate to 0.1 ft.

3. Logs will be prepared on a Soil Boring Log Form (Figure B-1).

4. Relevant information blanks in the log heading will be completed. If surveyed horizontal control is not available at the time of drilling, location sketches referenced by measured distances or prominent surface features (where present), will be shown on, or attached to the log.

5. Log scale will be 1 in. = 1 ft.

6. Material type encountered will be described on the log form.

7. Unconsolidated materials will be described as follows:

   a. Descriptive USCS classification in accordance with ASTM D 2488-84.
   b. Consistency of cohesive materials or apparent density of non-cohesive materials.

c. Moisture content assessment, e.g., moist, wet, saturated, etc.
d. Color.
e. Other descriptive features (bedding characteristics, organic materials, macrostructure of fine-grained soils, e.g., root holes, fractures, etc.)
f. Depositional type (alluvium, till, loess, etc.)
g. Fill material will be described using b, c, and d (above), plus organic material and content (e.g., wood, plastic, glass, paper, metal).

8. Logs will clearly show the depth intervals from which samples were collected.

9. Logs will identify the depth at which water is first encountered and the depth to water at the completion of drilling. The absence of water in borings will also be indicated. Where monitoring wells are installed, the stabilized depth to water will be recorded also. Stabilized water level data will include time allowed for levels to stabilize.

10. Logs will show borehole and sample diameters and depths at which drilling or sampling methods or equipment change.

11. Logs will show total depth of penetration and sampling. The bottom of the hole will be clearly identified on the log with the notation "Bottom of Hole."

12. Logs will document the use of drilling fluids, including: source of make-up water and additives by brand and product name. If drilling with compressed air, document the type of air filter used.

13. Logs will document drilling fluid losses including depths at which they occur, rate of loss, and total volume lost.

14. Logs will show the depth and type of temporary casing used, if any.

15. Logs will include all other information relevant to the investigation, including but not limited to:
Odors;
PID/FID measurements or other field screening or test results; and
Observed evidence of contamination in samples, cuttings, or drilling fluids.

1.5.2 Borehole Logging Requirements (Bedrock)

Borehole logging will include at a minimum,

1. Logs will be prepared on a Core Log Form (Figure B-2).

2. The core bit size shall be indicated on the first sheet of each Log of Core Boring.

3. Information will be recorded on the log in reference to the depth scale which is divided into 0.5-ft. increments. The field geologist/engineer shall indicate "tens" units on the depth-in-feet scale, as appropriate.

4. The geologist/engineer shall record drilling activities in chronological sequence and with respect to the depth scale. Equipment changes and shift start stop times are documented in this item with notation of time (24 hour clock) and date of occurrence and depth of the boring at the time of occurrence.

   Start and stop time (24 hour clock) for each core run shall be recorded. Interruptions in coring shall be documented by time of occurrence and description of the problem and its resolution. Coring rates and depths of changes in coring rate shall be recorded.

   The depths of intervals of nonrecovered core shall be identified and an evaluation of the reason for loss recorded.

   Casing depth, cement or grout used, changes in core bit size, and changes in color of circulating water/ drilling fluid shall be recorded. Quantitative estimates of fluid losses and gains and the interval over which they occur shall be indicated. These estimates shall take into consideration losses due to spillage and intentional wasting (i.e., recirculation tank cleaning). The brand name and amount of any bentonite used, the reason for its use, and start (by depth) of this use shall be recorded.

   A narrative description of all special problems and their resolutions shall be recorded on the boring log, (e.g., hole caving, recurring problems at a particular depth, excessive grout takes, plugging of the core barrel, unrecovered tools).

   A narrative description of the grouting of the borehole or the completion of the monitoring well shall be recorded on the boring log.

5. Core runs shall be numbered consecutively down the hole as performed and indicated on the log with horizontal lines at the appropriate depth and the core run number recorded in the lower left quadrant of the indicated core run.

6. Total core recovery shall be determined in feet ($\pm$ 0.1 ft) and recorded on the log.

7. Total core recovery as a percent of the length of the core run shall be determined for each core run and recorded on the log.

8. The Rock Quality Designation (RQD) as a percent of the length of the core run shall be determined for each core run and recorded on the log.

The RQD method of determining rock quality is as follows:

The sum of the total length of core recovered in each run, counting only those pieces of core which are 4 in. (10 cm) in length or longer and which are hard and sound, divided by the total length of the run, represented as a percentage. If the core is broken by handling or by the drilling process, the fresh broken pieces are fitted together and counted as one piece provided that they form the requisite length of at least 4 in. (10 cm).

Relation of RQD and Rock Quality

RQD (%)	Designation of Rock Quality
0 - 25	Very Poor
25 - 50	Poor
50 - 75	Fair
75 - 90	Good
90 - 100	Excellent

9. The standard name of the rock units intersected shall be indicated. Formation or member name or other geologic unit names shall be used when the stratigraphy is known.

10. The angle of bedding, foliation, schistosity, etc. shall be recorded as the dip angle as measured from the perpendicular to the core axis.

11. The angle of fracture, joint, fault, or seam surfaces shall be measured from the perpendicular to the core axis and graphically illustrated to scale.

12. The dominant type of coatings or fillings present in each of the fractures or seams shall be recorded. Slickensides shall be identified as dip-slip or strike-slip; or the "rake" in degrees recorded.

13. Standard rock symbols shall be used in the graphic log to show major variations in lithology; minor changes will be documented in the written lithologic log.

14. Rock cores shall be visually described for the following parameters:

    Lithology
    Grain Size and Texture
    Color
    Bedding/Foliation/Banding
    Hardness
    Degree of Weathering
    Solution or Void Conditions
    Permeability

1.6 Handling and Storage of Core

Cores shall be placed in wooden core boxes with the top and bottom of each run clearly labeled. Core is always placed so it can be "read" like a book, top at upper left; bottom at lower right. For the standard hinged core box, the hinged side is designated the "upper side" of the box. Any breaks that are made to fit the core into the boxes shall be clearly marked and identified as such.

Wooden spacers showing the footage at the beginning and end of each run shall be placed in the boxes. Spacers should also be used to fill in zones of no core recovery. In addition, core boxes should be clearly marked on the inside and outside of top cover and each outside end to identify the job number, the boring number, the numerical sequence of the box (i.e., 2 of 7), and the footage interval within the box.

When it is necessary to split cores for detailed examination, the cores should be handled carefully and put back into the box in the same position they were prior to splitting.

Cores are to be stored and secured in a dry location out of weather.

1.7 Backfilling

Soil borings will be completed as monitoring wells. In the event that borehole location has to be abandoned (e.g., auger refusal from debris or boulder) the borehole will be abandoned in one of two ways depending on subsurface material. If the abandoned borehole is located within natural material (sand, silt), the borehole will be backfilled with cement grout (Section 2.2.4). If the abandoned borehole is located within the landfill debris, bentonite pellets/chips will be used instead of cement grout.

2. MONITORING WELLS

This section presents procedures for monitoring well installation, well material specifications, well development, permeability testing, and packer testing.

2.1 Installation

2.1.1 Installation Interval

2.1.1.1 Site 03

The four monitoring wells will be screened in the lower 10 ft of the unconsolidated material. Well construction materials, including screen and riser pipe, filter pack, bentonite and grout seal, locking expandable cap, and protective cover, are specified in Section 2.2.

2.1.1.2 Site 09

Five monitoring wells are planned to be installed. Two shallow monitoring wells (09-MW-14 and 09-MW-15) will be screened at the base of the upper aquifer using 10 ft of screen set approximately 1 ft into the silt unit. One monitoring well, O9-MW-16, will be screened at the base of the silt unit (the lower 5 ft of the unit) and with steel casing set approximately 5-10 ft into the upper portion of the unit. Two wells (09-MW-17 and 09-MW-18) will be installed and screened approximately 20-30 ft into bedrock, if steel casing is used, it will be set 5 - 10 ft into the silt unit (see Section 1.2.1). Well construction materials, including screen and riser pipe, filter pack, bentonite and grout seal, locking expandable cap, and protective cover, are specified in Section 2.2.

2.1.2 Monitoring Well Construction

The soil borings for the monitoring wells to be installed screened in unconsolidated material will be drilled using the procedures specified in Section 1.2.1. The screen and riser pipe (specified in Section 2.2.1) will be installed through the augers or casing with the screen positioned as described in Section 2.1.1.

Following placement of the well screen, sand for the filter pack (specified in Section 2.2.2) will then be poured through the annular space between the well pipe and sides of the augers or casing. When drilling "mud" is used, the "mud" will be thinned to water viscosity prior to placement of the filter sand. For borings 09-MW-14 and 09-MW-15, the augers will be withdrawn incrementally as the sand is placed into the well. The sand will be placed 1 ft below the bottom of, and to a minimum of 2 ft and a maximum of 4 ft above the top of the screen. If the total depth of a well exceeds 25 ft, the sand will be installed through a tremie pipe.

Following placement of the sand, a bentonite seal (specified in Section 2.2.3) will be placed through the augers or casing in a manner similar to the filter pack. The bentonite seal will be placed above the filter pack to prevent intrusion of the grout into the filter sand. The minimum thickness of the bentonite seal will be 2 ft. The bentonite seal will be allowed to hydrate a minimum of 1 hour before grouting begins.

Following placement of the bentonite seal, the augers (if used) will be withdrawn and the remainder of the annular space will be sealed with a cement-bentonite grout (specified in Section 2.2.4). A cement grout will be placed in the annular space between the well casing and the boring (or steel casing) from the top of the bentonite seal to the ground surface. Grout will be placed by pumping through a side discharge tremie tube with the lower end of the tube within 3 ft of the top of the bentonite seal. Pumping will continue until undiluted grout flows from the boring at the ground surface. Should the top of the bentonite seal occur within 5 ft of the ground surface, the grout will be poured into the borehole annular space from the ground surface.

Following completion of the grouting operations, each well will be completed with a locking expandable cap and a surficial protective steel casing or box (Section 2.1.3). Figure B-3, B-4, and B-5 present examples of well construction diagrams which will be prepared for each installation.

2.1.3 Protection and Completion of Wells

Throughout the progress of the work, precautions will be taken to prevent tampering with the well or entrance of foreign material into it. Runoff will be prevented from entering the well during construction.

The riser pipe of each well will be completed above grade and will be surrounded by a larger diameter protective steel casing rising 3 ft above ground level and set an approximately equal distance below the ground surface into the cement grout backfill. The casing shall be installed in a manner that does not hinder access to the monitoring well for purposes of taking samples or water level measurements.

A minimum 3 ft by 3 ft square by 4-in. thick concrete pad, sloped away from the well, will be constructed around the well casing with the top outer edge at the final ground level elevation. Three 2-in. diameter or larger steel posts will be equally spaced around the well and cemented in place outside the concrete pad. The ground immediately surrounding the top of the well will be sloped away from the well.

2.2 Well Construction Materials

2.2.1 Well Riser and Screen

Well riser pipe will consist of new, 2-in. ID, threaded, flush-joint, Schedule 40, polyvinyl chloride (PVC). The pipe will bear markings that will identify the material as that which is specified. Each section will be joined by threaded flush-joint couplings to form water-tight seals. No organic solvents or glue will be used in joining the pipe. The use of a Teflon tape on threaded joints is acceptable on an as-needed basis, and will be noted on the well construction log.

Except for the two shallow wells (09-MW-14 and 09-MW-15), well screens will consist of new, commercially fabricated, threaded 10-ft, flush-joint, continuous 10-slot, 2-in. diameter PVC. A threaded PVC cap or plug will be placed on the bottom of the well.

For 09-MW-14 and 09-MW-15 at Site 09, stainless steel continuous wrap well screen and end caps will be used in place of PVC. Stainless steel well screens have been selected over PVC due to the potential presence of chlorinated solvents at high concentrations (and possibly DNAPL). Chlorinated solvents can deteriorate (weaken) PVC materials causing screen slots to close shut under the weight of the well, thus jeopardizing the integrity of the well and ground-water samples.

Well screens and riser will be steam-cleaned prior to installation unless they arrive and are maintained on site in the factory provided packaging.

2.2.2 Filter Pack

The annular space around the well screen will be backfilled with a clean, washed, well-rounded silica sand sized to perform as a filter between the formation material and the well screen. It is anticipated that a "20/40" sand is an appropriate gradation for the planned monitoring wells. The grain size of the filter pack which is used will be included on the well construction diagram.

2.2.3 Bentonite Seal

The seal will be comprised of commercially-manufactured sodium bentonite pellets and granules, not exceeding 0.5 in. in diameter.

2.2.4 Grout Mixture

The cement grout will consist of Type I or II Portland cement (ASTM-C150) and water added in the proportion of no more than 7 gal per 94-lb bag of cement. Additionally, 3 percent by weight of bentonite powder may be added to the mixture to help reduce shrinkage.

2.3 Well Numbering and Labelling

Monitoring wells will be numbered sequentially. A permanent corrosion-resistant tag identifying the well number, depth, date of installation, and top of the inside well casing elevation will be affixed to the locking expandable cap with steel wire.

2.4 Monitoring Well Development

The monitoring wells will be developed immediately upon completion (prior to grouting) or no sooner than 48 hours after grouting is completed. Development protocol will be as follows:

a. Measure static water level. Water levels will be measured using a properly decontaminated interface probe capable of detecting both separate-phase (NAPL) and water levels. The probe will be capable of measuring liquid depth to an accuracy of 0.01 ft.

b. Measure total well depth.

c. Develop the well by alternately surging (via a clean surge block or bailer) and pumping to remove "fines" from the well screen and filter sand. Continue this procedure until little or no sediment enters the well but for no less than 2 hours. At the end of that time, the well will be continuously pumped using an electric submersible pump (or centrifugal pump, if the depth to water is less than 15 to 20 ft. below grade). Temperature, pH, specific conductivity, and turbidity of the ground-water will be monitored during pumping. Pumping will continue until these parameters have stabilized (less than $\pm$ 0.2 pH units variation and less than a 10 percent change for other parameters between four consecutive readings) and the water is clear and free of "fines". If the parameters have not stabilized after 4 hours of continuous pumping, the CTO Manager will be notified.

   If well yield is too low to permit continuous pumping or bailing, the well will be bailed or pumped dry three times.

   If any water was introduced during drilling operations, at a minimum, that amount will be removed during development.

d. Purge and development water shall be containerized and labelled. The drum labelling will include: date; well number; site name or number; accumulation start date; and telephone number of the EA office and the POC. Hazardous waste labels shall not be placed on the drums until the drum contents have been conclusively determined as hazardous as a result of the laboratory analyses. At least one label will be located on the side of the drum. A secondary label may be placed on the top of the drum, if necessary. Waste handling procedures are further discussed in Section 7.2.

2.4.1 Well Development Records

A well development form will be prepared and completed for each monitoring well installed. The form will be prepared by the geologist or geotechnical engineer present during the well development operations. A sample form is included as Figure B-3. Information provided on the well development record will include, but not be limited to, the following:

- Name of project and site, well identification number, and date(s).
- Date, time, and elevation of the static water level and bottom of well before development.
- Method used for development, to include: equipment, size, type, make of bailer and/or pump used during development, and decontamination procedures.
- Time spent developing the well by each method, to include the typical pumping rate if a pump was used in development.
- Volume and physical character of water removed, to include changes during development in clarity, color, particulates, and odor.
- Volume and source of water added to the well, and chemical analysis of the added water.
- Volume and physical character of sediment removed, to include changes during development in color and odor.
- Clarity of water before, during, and after development, including thickness of any sediment which settles to the bottom of the jar containing the last one liter of water withdrawn from the well during development.
- Total depth of well and the static water level immediately after, and approximately 24 hours after development.
- Readings of pH, dissolved oxygen, PID screening, specific conductance, temperature, and turbidity taken before, during, and after development.
- Name(s) and job title of individual(s) developing well.
- Name and/or description of the disposal facility/area for the waters removed during development.

2.5 *In Situ* Permeability Testing

An *In Situ* permeability test will be performed on the three newly installed overburden wells at Site 09 and the four newly installed wells at Site 03, after development. The permeability tests will be "slug out" or "rising head" tests. A known volume (slug) of water will be removed from each well using a new clean disposable bailer which should instantaneously and temporarily lower the water level in the well. Immediately, recording of the water level rise (recovery) will begin and continue using an In-Situ pressure transducer and data logger, or similar equipment, until at least 80 percent (as possible) of the recovery to the static water level in achieved. Data logging will be performed in accordance with the instructions stated in the equipment operator's manual. The recorded data will be evaluated to estimate hydraulic conductivity (K).

2.6 Packer Testing

Water pressure tests or "packer tests" are in-situ tests performed and used to estimate permeability of a specific zone in a bedrock borehole. Water pressure tests are used to estimate bedrock permeabilities for hydrogeologic studies.

Packer tests will be performed after borehole (not well) development is completed. A five foot section of the borehole is sealed off with the pneumatic packers. Water is then pumped through the zone between the packers at a known pressure. The rate of flow into the formation is measured with a flow meter. The permeability of the test zone is then calculated using the data obtained in the test. The packer testing will start at the bottom of the borehole, and proceed upward in 5 ft increments until the top of bedrock is encountered. A typical configuration for the packer test equipment is shown in Figure B-7.

2.6.1 Methodology

The following methodology will be used to conduct the packer test.

1. Flush the borehole with clean water to remove cuttings. Measure the depth of the borehole, and check for caving.

2. Maintain the test pressures at the pump below the Maximum Water Pressure (Pmax). This should avoid the chance of hydrofracturing (loosening) the rock mass. Pmax is determined by the following formula:

   $$Pmax = (H_1)\ (1\ psi/ft)$$

   Note: (In highly fractured rock this should not exceed 0.75 psi/ft.)

   where,

   H_1 = depth in feet from ground surface to the bottom of the upper packer

During test operations the water pressures are observed at the gauge. The Maximum Gauge Pressure (GPmax) is calculated by the following formula:

$$Gpmax = (H_1 + H_3)\ (1\ psi/ft) - (H_1 - H_2)\ (0.43\ psi/ft)$$

where,

H_1 = depth in feet from ground surface to the bottom of the upper packer.

H_2 = depth in feet from ground surface to the static water level.

H_3 = height in feet of pressure gauge above ground surface.

3. Ensure that the packer system is not leaking.

4. Determine the Packer Inflation Pressure (PIP), by performing the following steps:

Step 1 - Establish Minimum Inflation Pressure (MIP) (i.e., the pressure required to inflate the packers in the casing so that they can no longer be pushed or pulled through the casing).

Step 2 - Establish the Static Head Pressure (Ps) in psi at the test depth by the following calculation:

$$Ps = (H_1 - H_2)\ (0.43\ psi/ft)$$

where,

H_1 and H_2 are as above

Step 3 - Make sure the Packer Inflation Pressure (PIP) equals the Minimum Inflation Pressure (MIP) plus the Static Head Pressure plus the Maximum Gauge Pressure (Gpmax) of the test zone between the packers. This is sometimes written as follows:

$$PIP = MIP + Ps + Gpmax$$

5. Determine the static water level in the borehole prior to the installation of the packer.

6. Assemble and install the pneumatic packer equipment in the borehole.

7. Before performing the first test, bleed air out of the lines by forcing water through the packer system assembly before the packers are inflated. Inflate both packers to the required packer pressure.

8. Before starting the test, review the Packer Test Data Sheets (Figure B-7) and record the following:

   - Test number
   - Test section (i.e., length)
   - Hole size
   - Height of pressure gauge above ground surface
   - Ground surface elevation
   - Depths of rock surface, ground water, bottom of boring, bottom of upper packer, and to top of lower packer

9. Conduct the bedrock packer test in three steps. During the testing activity, periodically measure and record the depth to water in the tested borehole. A sudden rise in the water level or the presence of bubbles could indicate leakage around the packers. This should be resolved by resetting the packers.

   Step 1 - 1/2 Gpmax

   Pump water into the system and record observations of gauge pressure and water meter at 30-second intervals for at least three to five minutes after a constant rate of flow is reached.

   Step 2 - Full Gpmax

   Pump water into system and record observations of gauge pressure and water meter at 30-second intervals for at least three to five minutes after a constant rate of flow is reached.

   Step 3 - Full Gpmax plus 20 psi increase on the Packer Inflation Pressure

   Increase packer Inflation Pressure by 20 psi. Pump water into the system and record observations of gauge pressure and water meter at 30-second intervals for at least three to five minutes after a constant rate of flow is reached. The results of Steps 2 and 3 should be similar. If they are not, Step 3 should be repeated, increasing the Packer Inflation Pressure by an additional 20 psi. This is done to check for leakage past the packers.

10. If leakage of water from the packed section into the surrounding rock is so great that the GPmax cannot be achieved, operate the pump at its full capacity with the bypass valve closed. Record the volume of water pumped into the test section and the associated pressure readings at timed intervals. This data will give a minimum value of the rock permeability.

11. Upon completion of the test, deflate the packers and move to the next test depth. Complete data sheets (see Figure B-8). Testing will proceed from the bottom of the borehole to the top of rock at 5-ft intervals.

2.6.2 Computed Rock Mass Permeability

Compute the rock mass permeability. Additional data required for each test are as follows:

(1) depth of hole at time of each test;
(2) depth to bottom of top packer;
(3) depth to top of bottom packer;
(4) depth to water level in borehole at frequent intervals;
(5) elevation of potentiometric level;
(6) length of test section;
(7) radius of hole;
(8) length of packer;
(9) height of pressure gauge above ground surface;
(10) height of water swivel above ground surface; and
(11) description of material tested.

Item (4) is important because a rise in water level in the borehole may indicate leakage from the test section or an interconnected bedrock fracture pattern. A sketch of the test equipment arrangement showing the relative portions of the components should be made for each configuration used.

The formulas used to compute the permeability from pressure test data are:

$$\mathbf{K} = (Q/2\pi LH) \quad \ln(L/r)$$

When L ⟩ 10r

(the above formula is used when the length is greater then ten times the radius)

and,

$$\mathbf{K} = (Q/2\pi LH) \quad \sinh^{-1}(L/2r)$$

When 10r ⟩ L ⟩ r

(the above formula is used when the length is greater than the radius but less than ten times the radius)

where,

K = permeability
Q = constant rate of flow into the hole
L = length of the test section
H = differential head on the test section
r = radius of the borehole

It should be noted that when the test is conducted above the water table, H is the distance from the water pressure gauge to the middle of the test section. When the test is conducted below the water table, H is the distance from the gauge to the static water level.

2.7 Salinity Measurements/Monitoring of Bedrock Aquifer

Tidal and ground water monitoring program will be conducted at Site 09 for a two to three day period. Pressure transducers (10-20 psi) will be installed in eight monitoring wells (09-MW-3D, -6D, -9D, -10D, -13D, and -14 through -18). The pressure transducers will be connected to a data receiver (Hermit) to record the water level fluctuations over time. A tidal gauge, which measures changes hydraulic pressure, will be installed to monitor tidal changes in Allen Harbor for the same period.

Water levels in all monitoring wells will be manually measured at least three times daily during the monitoring period using an electric water level indicator or interface probe. Salinity measurements will be conducted at least three times on all monitoring wells when the water levels are manually measured. The existing piezometers will not be measured for salinity because the salinity meter probe will not fit into the one-inch piezometers.

3. FIELD SAMPLING PROCEDURES

The following subsections present the field procedures for collecting soil and ground-water samples.

3.1 Soil Boring Samples

Soil sampling will be conducted in a manner necessary to minimize interaction of the sample with the surface environment. The protocol and equipment for collection of soil samples are described in the following subsections.

In order to recover an adequate volume for laboratory analysis, 24-in. long stainless-steel split spoons will be used. The sample intervals will be noted in the sampling book. The headspace vapor of soil collected by split-spoon samplers will be screened using a PID (Section 3.1.1) or field GC (Section 3.1.2). Screening results will be noted on the boring log. Site specific sampling intervals are listed below.

Site 03

Split-spoon sampling of the soil will be performed every 5 feet to the bottom of the boring (bedrock). The soil samples will be used for general stratigraphic identification, field GC analysis (Section 3.1.2), and chemical analysis (Section 3.1.3). Prior to each use, the sampler will be decontaminated as presented in Section 7.1.2.

Site 09

In the boreholes for the shallow monitoring wells, split-spoon sampling of the soil will be performed every 5 ft to a depth of about 20 ft below ground surface, and then, continuously to about 5 ft into the gray silt unit. The borehole for the monitoring well to be installed in the silt unit will be sampled in the same manner as the shallow wells, then continued at 5-ft intervals to the top of bedrock. In the boreholes for wells to be completed in bedrock, split-spoon sampling of the soil will be performed every 5 ft to the top of bedrock. The soil samples will be used for general stratigraphic identification, headspace vapor analysis (Section 3.1.1), and chemical analysis (Section 3.1.3). Prior to each use, the sampler will be decontaminated as presented in Section 7.1.2.

3.1.1 Headspace Vapor Screening

The headspace vapor screening method requires that soil be collected from every split spoon and containerized. Field headspace screening of soil samples shall be conducted in accordance with the following procedures:

- Immediately upon opening the split-spoon (or other sample retrieval device) and after collecting the volatile organic sample, if required), a representative portion of the sample shall be collected and placed in a clean, contaminant-free jar.

- If the volume of sample recovered is insufficient for all analytical requirements, then the material used in the headspace readings could be utilized for any non-volatile sample aliquot requirements.

  NOTE: If, due to insufficient sample volume, an additional sample was retrieved immediately below the initial attempt, and additional headspace reading is not required.

- Seal each jar with at least one continuous sheet of aluminum foil, using the jar lid to secure the foil.

- Vigorously agitate the sample jar for at least fifteen seconds and then allow a minimum of ten minutes (or as the environmental conditions dictate) for the sample to adequately volatize.

- During cold weather the samples shall be warmed to near room temperature (60 - 70° F) prior to taking the headspace measurement.

- Re-shake the jar and then remove the jar lid. Quickly insert the vapor sampling probe of a PID with an 11.7 ev lamp through the aluminum foil and record the maximum meter response (which should be within the first two to five seconds). Exercise care to avoid the uptake of water droplets or soil particles. Erratic responses should be evaluated in terms of high organic vapor concentrations or conditions of elevated headspace moisture.

- Record headspace screening data on the boring log and any other appropriate documentation (e.g., sample transmittals, field notebooks, etc.) as appropriate.

- The screening instrument (PID) shall be calibrated according to the appropriate standard span gas and shall be calibrated a minimum of three times daily and before use and after a long shut down period (i.e., lunch breaks, equipment breakdowns, weather caused breaks, etc.)

- If sample jars are to be re-used in the field, jars must be cleaned according to field decontamination procedures for cleaning of sampling equipment (Section 7.1.2.2). In addition, headspace readings must be taken prior to reuse to ensure no residual organic vapors in the cleaned sample jars.

3.1.2 Gas Chromatograph (GC) Field Screening

At Site 03, all soil samples collected from drilling activities will be screened for VOC using an onsite gas chromatograph (Varian Model 3300 or similar), by "purge and trap/gas chromatography" (EPA Level II data screening). Soil samples will be selected for more qualitative and quantitative laboratory analysis based on the analytical results obtained from the onsite analysis. Soil samples will be analyzed onsite following a modified EPA SW-846 8010 methodology. The following is a synopsis of the method.

> Approximately 5 grams of a soil sample will be placed in the purging vessel. Five ml of laboratory grade distilled water is then added to the purging vessel. The vessel is then placed on the purge and trap apparatus, and a heating jacket is placed around the vessel to facilitate volatilization of organic compounds. Helium or nitrogen is bubbled through the sample, sparging the compounds from the sample. The compounds sparged from the sample are absorbed onto a "Tenax" trap. The trap is a stainless steel tube approximately 24 cm x 4 mm i.d. packed with a "Tenax" polymer. The "Tenax" trap is then heated and backflushed. This allows the compounds to be desorbed from the trap and injected into the gas chromatograph (GC) for analysis.
>
> When the sample is injected into the GC, the individual compounds of the sample are first separated by an analytical column. As the separated compounds elute from the GC column, they enter the detectors where an electrical signal is produced. The signal is then amplified, integrated, and reported as a chromatographic peak. Because chlorinated solvents are the compounds of concern at Site 03, an Electron Capture Detector (ECD) will be used.
>
> Concurrent with compounds eluting from the GC column, the data station prints out a chromatogram which is a continuous graph of the ECD response to the eluting compounds. Subsequently, a summary of retention times and response factors (peak area) is printed. Essentially, a calibration analyte (e.g. Trichloroethene) has a known retention time and known GC response to calibrating concentration; therefore, the corresponding chromatogram peak for a sample run can be identified by retention time and quantified by comparison to the calibration response.
>
> The GC analytical system will be calibrated using aqueous standards of selected analytes. The aqueous standards will consist of cis, and trans, 1,2-Dichloroethene, Trichloroethene, 1,1,2 - Trichloroethane, and 1,1,2,2 - Tetrachloroethane. The detection limits for these compounds are 20 ppb, 5 ppb, 5 ppb, and 5 ppb, respectively. These compounds were previously detected in the ground-water samples at Site 03 and are the compounds of concern during this investigation.
>
> Calibration standards will be analyzed, each day, prior to any sample analysis and approximately every eight samples there after. QC sample blanks and duplicates will be analyzed periodically throughout the screening process. The data will be reduced by the onsite environmental chemist. All field analytical data will be reviewed by a senior environmental chemist.

3.1.3 Soil Boring Sampling for Chemical Analysis

Each sample will be obtained with a stainless-steel 24-in. split-spoon sampler. Soil samples will be collected for analysis of TCL VOC (based on headspace screening from either hand held instruments, GC Screening for Site 03, or field observations).

If headspace screening does not show elevated readings, then soil samples will be selected for analysis based on the following at Site 09. **Shallow borings:** one sample from approximately 2 to 4 ft into native material (below landfill debris) and one sample from approximately 2 to 4 ft above the sand/silt interface at the base of the upper aquifer; **Silt well:** one sample from approximately 2 to 4 ft below the bottom of the outer casing and one sample from the bottom 5 ft of the silt unit; **Bedrock wells:** one sample from approximately 2 to 4 ft above the sand/silt interface (bottom of the upper aquifer) and from the bottom 3 to 5 ft of the lower aquifer (above the bedrock).

At Site 03, two soil samples will be selected for TCL VOC laboratory analyses based on GC headspace screening results. If no VOC are detected, then, soil samples from 2 to 4 ft above and 10 to 12 ft below the water table will be selected for offsite analysis.

Collection of the VOC soil sample aliquot will occur, without mixing, immediately upon the opening of the split-spoon. Slough will not be included as part of the soil sample.

3.2 Monitoring Well Sampling

Wells will be allowed to stabilize at least 2 weeks after development and prior to sampling. Rapid and significant changes can occur in ground-water samples upon exposure to the surface (exposure to sunlight, temperature, and pressure changes). Therefore, ground-water sampling will be conducted in a manner which will minimize interaction of the sample and the surface environment. The equipment and protocol for collecting ground-water samples follows.

3.2.1 Sampling Equipment

Ground-water samples will be collected from monitoring wells using Teflon bailers. Nylon twine will be attached to each bailer to lower and raise it into the monitoring well; the twine will be replaced between sampling events. A submersible pump will be used to purge each well before sampling.

3.2.2 Field Analytical Equipment

Field analytical equipment to be employed at NCBC - Davisville will include a pH meter, dissolved oxygen meter, thermometer, conductivity meter, turbidity meter, oil/water interface probe, water level indicator, and a PID. Each piece of equipment will be checked by EA to be in proper working order before its use. After each use, the instrument will be checked, cleaned, dried, and stored in an area shielded from weather conditions.

A permanently bound logbook will be maintained for the field instruments used. This logbook will contain information about the instrument including: calibration; field repairs; and serial numbers. Instruments will be calibrated before sampling each day, before afternoon work, at the end of the day, and on an as-needed basis in accordance with the manufacturer's instructions.

3.2.3 Ground-water Sampling

The sampling protocol will be as follows:

a. Measure Water Level
Using a properly cleaned oil/water interface probe (see Section 7.1.2.2 for decontamination procedures), determine the water level in each well and the total well depth. Calculate the fluid volume in the casing and screen. Prior to purging any well, determine the presence of dense non-aqueous phase liquid (DNAPL) using an oil/water interface probe. If a DNAPL is present, a sample of the product will be obtained, packaged, and shipped to the laboratory for chemical analysis, but no ground-water sample will be collected.

b. Purge Well
Purge each well for a minimum of three fluid volumes and then, until the pH, specific conductance, and temperature have stabilized (less than $\pm$ 0.2 pH units and less than a 10 percent change for the other parameters between four consecutive readings). If after five fluid casing volumes, the parameters have not stabilized to within acceptable units, the EA field team leader and the CTO Manager will be notified immediately for further instructions.

If the well does not recharge within one hour to permit at least three volumes to be removed, record the volume removed, and sample as soon as sufficient recharge has occurred. Then, notify the CTO Manager.

c. Collect Sample

Sample collection should start at the least contaminated well and to proceed to the most contaminated well. One trip blank will be included per shipping cooler containing water samples to be analyzed for volatile organic compounds. A field duplicate ground-water sample will be collected from the well having the highest PID or GC screening measurement of soil samples obtained during the drilling. See Table 4-4 and 4-12 for the number of field duplicate and trip blank samples which will be collected at each site.

Lower the bailer slowly until it contacts the water surface and allow the bailer to sink to the desired depth and fill with a minimum of surface disturbance. Slowly withdraw the bailer, being careful to prevent contact of the bailer line with the ground. Tip the bailer and slowly discharge the contents into the appropriate sample containers. Repeat the process as necessary to fill each container to the required aliquot volume. Vials for TCL VOC analysis will be completely filled without headspace above the liquid portion (to minimize volatilization). Check that a Teflon-lined silicone septum is correctly placed in the cap and secure the cap tightly. After the cap is sealed, vials should be inverted and checked for bubbles. If bubbles are present, they should be eliminated by adding additional sample water before the vial is resealed. The sample aliquots will be placed into pre-cleaned containers provided and designated by the laboratory (see Table 4-2). As each sample is obtained, measurements and observations will be recorded in the field sampling report (Figure B-9).

Hydrochloric acid will be added as a preservative to the VOC vials prior to shipment by the laboratory.

3.2.4 Separate-Phase Hydrocarbon Sampling

In the event that a layer of DNAPL is found in the monitoring wells, the depth to and thickness of the detected DNAPL will be documented. A sample of the DNAPL will be collected and shipped to the laboratory, where it will be analyzed for its constituents components. Ground-water samples will not be collected from wells containing DNAPL (separate-phase product).

4. PACKAGING AND SHIPPING

4.1 Sample Designation and Labeling

Once the sample is collected, label the appropriate sample bottle with the appropriate sample tag and provide the following data: sample identification number, project number and name, date, time, sampler's signature, number of containers per analyte, analysis requested, and preservative(s) added.

EA will employ the following coding (sample designation) system:

I. Soil Samples
Example: SB-01-1.0-3.0
>SB = Soil Boring
>First dash number from left to right indicates the location of the soil boring.
>Second dash number from left to right indicated the top of the sampling interval in feet.
>Third dash number from left to right indicates the bottom of the sampling interval in feet.

II. Ground-water Samples
Example: MW-01
>MW = Monitoring Well
>First dash number indicates the position of the monitoring well.

III. Quality Assurance Samples
Example: MW-01QA
>A "QA" after the sample number designates a quality assurance sample. Quality assurance split will be identified both on the sample label, Chain-of-Custody. The QA designation will be followed by a sample designation (i.e. DUP, Field Blank, etc.)

4.2 Handling, Custody, and Shipping

Seal the sample containers with custody tape (for VOC vials, seal the vials in a quart plastic baggie and attach the custody seal around the baggie). Complete Chain-of-Custody document (Figure B-10) entries and record the sampling event in the bound field notebook in indelible ink.

The properly labeled and sealed containers will be placed in a plastic "ziplock" type bag and sealed. Approximately 3 in. of inert cushioning and absorbing material (i.e., bubble wrap) will be placed in the bottom of the cooler. The sample will be packed in "blue ice" or ice which has been double bagged with heavy duty polyethylene bags, prior to placement into the cooler. Samples will be packed so as to maintain a temperature of 4° C.

The Chain-of-Custody form will be sealed in air-tight plastic bags and taped to the inside of the cooler lid. The lid of the cooler will be sealed with a custody seal. Clear adhesive tape will be placed over the custody seal to ensure that the seal is not accidentally broken during shipment.. The lid of the cooler will then be sealed with fiber or duct tape. Samples will be shipped to the laboratory via overnight courier on the day they are collected. IEA Laboratory will be notified by phone of the sample shipment at least 24 hours before arrival and 48 hours before arrival if the arrival is to occur on a Saturday. IEA Laboratory will be notified 1 week prior to the beginning of sampling. The containers for each matrix are listed in Tables 4-1 and 4-2.

A Cooler Receipt Form (Figure B-11) must also accompany the Chain-of-Custody form. Upon receipt of the cooler at IEA Laboratories, the receiver will open the cooler, remove the Chain-of-Custody Form and Cooler Receipt Form, and complete the Preliminary Examination Phase portion of the Cooler Receipt Form. After the samples have been logged in the Log-In Phase of the Cooler Receipt Form, will be completed. The Cooler Receipt Form must accompany and be part of the Chain-of-Custody Form.

5. SAMPLE DOCUMENTATION

The documentation necessary for this investigation includes the following:

- Field Notebook
- Chain-of-Custody Form
- Cooler Receipt Form
- Field Sampling Form

5.1 Field Notebook

The EA CTO Manager will control all field notebooks. Each field notebook will receive a serialized number and be issued to the field team leader. Field notebooks will be bound books, preferably with consecutively numbered pages, that are at least 4 1/2 in. × 7 in. in size. Field notebooks will be maintained by the EA field team leader and other team members to provide a daily record of significant events, observations, and measurements during the field investigation. All notebook entries will be signed and dated.

All information pertinent to the field survey and/or sampling will be recorded in the notebooks. Field notebook entries will include the following information (at a minimum):

- Name and address of field contact.
- Name and title of author, date and time of entry, and physical/environmental. conditions during field activity.
- Names and titles of field crew.
- Names and titles of any site visitors.
- Type of sampling activity.
- Location of sampling activity.
- Description of sampling point(s).
- Date and time of sample collection.
- Sample media (e.g., soil, sediment, ground-water, etc.).
- Number and volume of sample(s) taken.
- Analyses to be performed.
- Field observations.
- Calibration/Maintenance requirements of field equipment.
- References for maps and photographs of the sampling site(s).

Original data recorded in either the field notebooks, on sample labels, or in the chain-of-custody records will be written with waterproof ink. None of these accountable, serialized documents will be destroyed or discarded, even if they are illegible or contain inaccuracies.

If an error is made on an accountable document assigned to an individual, that individual will make all corrections by crossing a line through the error and entering the correct information and initialing the cross-out. The erroneous information will not be obliterated. Any subsequent error discovered on an accountable document will be corrected by the person who made the entry, and will be initialed and dated, as appropriate.

5.2 Chain-of-Custody and Cooler Receipt Forms

A completed Chain-of-Custody (COC) Form will accompany the samples shipped to the laboratory and will contain the following information:

- Project name and EA project number.
- Name of person collecting samples.
- Date and time samples were collected.
- Type of sampling conducted (composite/grab).
- Parameters and method for analysis.
- Location of sampling station.
- Field filtration/preservation methods.
- Number and type of containers used.
- Signature of EA field personnel relinquishing sample.
- Date and time of custody transfer to overnight courier.
- Sample shipper (UPS, Federal Express, etc.).

Figure B-10 is an example COC Form. Figure B-11 is an example of a Cooler Receipt Form. These forms will be completed by the sampling team and included with the samples.

5.3 Field Sampling Form

This document is used by the person sampling to record the physical measurements of the sample information, and also, as a reference. Figure B-9 is an example of a Field Sampling Form.

6. SURVEYS

Sampling locations will be staked to facilitate subsequent surveying. EA will subcontract surveys required for this project and will supply the original or a legible reproducible copy of the surveys and field books. The surveys will, at a minimum, conform to the requirements stated in the following paragraphs.

6.1 Monitoring Wells

Coordinates and elevations will be established for each monitoring well. The coordinates will be to the closest 1 ft and referenced to the Rhode Island State Plane Coordinate System. If the State Plane Coordinate System is not available, an existing local grid system will be used. A ground elevation to the closest 0.10 ft and an elevation for the top of the well riser to the closest 0.01 ft will be obtained at each well. These elevations will be referenced to Mean Sea Level, specifically to the National Geodetic Vertical Datum of 1983. If the 1983 Datum is not available, the National Geodetic Vertical 1929 Datum will be used. Positions and coordinates of the permanent points within the control traverse will be shown.

6.2 Soil Borings/Sampling Points

Soil sampling locations will be located horizontally and vertically following the same procedures outlined in Section 6.1.

6.3 Physical Features

At each site, above-ground and, where possible, underground physical features, will be verified with previous mapping. Above-ground physical features will be located/verified to the nearest foot.

6.4 Documentation

The location, identification, coordinates, and elevations of the monitoring wells, soil borings, and monuments will be plotted on maps with a scale large enough to show their location with reference to other structures at the Site.

7. DECONTAMINATION AND WASTE HANDLING PROCEDURES

7.1 Decontamination

The primary objective of the decontamination process is to prevent the accidental introduction of potential contaminants to non-contaminated areas and/or samples. This section describes the methods associated with decontamination of field equipment. The Safety, Health, and Emergency Response Plan (SHERP) addresses personnel decontamination.

7.1.1 Centralized Decontamination Area

EA will identify a decontamination area at NCBC - Davisville that will be mutually acceptable to Northern Division. The selected area should have reasonable access to the approved water source. The approved area should also be large enough to store cleaned equipment prior to use and to stage drums containing removed material and cleaning solutions. This area should be at least 20 × 50 ft and should include a vehicle decontamination area as well as an area for equipment decontamination activities.

The approved decontamination area will contain a wash solution collection system. The collected material will be contained in DOT approved 17H 55-gal drums that are suitable for storage of liquid hazardous materials. Drums will be labeled and moved to a designated staging area. NCBC-Davisville will provide storage facilities in the designated area.

Wash tubs used in the field to clean split-barrel samplers between samples will be emptied into a DOT approved 17H 55-gal drum.

7.1.2 Decontamination Procedures

7.1.2.1 Drill, Rig, and Downhole Drill Tools

Equipment that will be used during drilling and well development activities will be steam cleaned prior to use. Equipment will be kept off the ground on clean sawhorses, racks, or pallets. If blowing dust is a problem, equipment shall be covered with plastic sheeting during storage.

Equipment to be decontaminated includes submersible pumps, augers, casings, samplers, tremie pipes, and cables. Downhole equipment and samplers used during drilling activities will also be cleaned between each use. Following a drilling operation and before moving to the next drilling location, augers, and downhole sampling equipment will be steam cleaned at the designated decontamination area. A vehicle decontamination platform with the capability to collect decontamination fluids will be provided.

7.1.2.2 Sampling Equipment

Ground-water and soil sampling equipment will be cleaned prior to use in the field. This equipment consists of bailers, hand augers, and sampling spoons. Wherever possible, sampling equipment will be dedicated to a single location to minimize potential for cross-contamination. Submersible pumps used for purging wells are not considered sampling equipment and will be decontaminated as per Section 7.1.2.1. Dedicated tubing will be used for each sampling location. During sampling activities, submersible pumps will be decontaminated onsite. All other non-dedicated sampling equipment will be decontaminated as described below.

Stainless Steel

This includes all spoons, spatulas, trowels and bowls, sediment corers, and other stainless steel equipment used for field activities:

1. Wash thoroughly using a brush and laboratory-grade glassware detergent, plus tap water.

2. Rinse with 10% nitric acid (if sampling for inorganics becomes required) (1% nitric acid on carbon steel split-spoons).

3. Rinse thoroughly with water from designated decontaminated water supply source.

4. Rinse equipment thoroughly with distilled and deionized water.

5. Rinse with pesticide grade methanol by spray bottle and allow to air dry.

6. Rinse with distilled deionized water.

7. Air-dry on clean polyethylene sheeting.

8. Wrap in aluminum foil, shiny side out for transport (if not being used immediately).

PVC or Glass Sampling Equipment

All PVC bailers and surface water collection bottles will be dedicated equipment that will not likely require in-field decontamination procedures. Decontamination procedures for this equipment, if required, are as specified for stainless steel equipment above.

Water Level Indicators

1. Wash with laboratory-grade glassware detergent and distilled, deionized water solution.

2. Rinse with tap water.

3. Rinse with pesticide grade methanol by spray bottle and allow to air dry.

4. Rinse with distilled and deionized water.

5. Store equipment in polyethylene bag during transport or storage.

7.2 Waste Handling Procedures

This section addresses the procedures for collection, storage, testing, and disposition of wastes generated during field activities.

7.2.1 Waste Collection and Storage

Drill cuttings, drill mud, well development water, well purging water, decontamination fluid, and other decontamination-related wastes will be containerized in DOT approved 55 gal. steel drums (17H for liquid waste, and 17E for solid wastes). Following site investigation activities and based upon the soil and water sample analytical results, soil and ground water from soil boring/monitoring well locations which showed an absence of contamination will be disposed of on site in the vicinity of the respective sampling location. Other Investigative Derived Waste (IDW) will be tested and disposed of accordingly.

7.2.1.1 Drill Cuttings

Drill cuttings will be containerized in DOT-approved 17E 55-gal drums. Drilling mud will be containerized in 17H 55-gal drums. Drums will be labeled with the soil boring designation number; date of collection; and name, affiliation, and phone number of the project geologist who collected the samples. The drums will be marked as IDW and will be transferred in the designated drum storage area for subsequent analysis and disposal.

7.2.1.2 Well Development and Purging Water

Water removed from new and existing monitoring wells for well development or sampling purposes will be containerized initially in DOT-approved 17H 55-gal drums at the time of generation. The drums will be labeled with the description of the drum contents; site name; well number; date the drum was filled; and the name, affiliation, and phone number of the individual responsible for filling and closing the containers. The drums will be marked as IDW and transferred to a designated drum storage area for subsequent analysis and disposal.

7.2.1.3 Decontamination Fluids

Liquid generated as a result of decontamination activities will be collected and containerized initially in DOT-approved 17H 55-gal storage drums at the time of generation. The drums will be labeled with the description of drum contents; date the drum was filled; and the name, affiliation, and phone number of the individual responsible for filling and closing the containers. The drums will be marked as IDW and transferred to a designated drum storage area for subsequent analysis and disposal.

7.2.1.4 Other Decontamination Waste

Other wastes generated during decontamination activities, including discarded personal protective equipment, aluminum foil, and other debris, will be collected and containerized in DOT-approved 17E 55-gal drums labeled with the description of drum contents; date the drum was filled; and the name, affiliation, and phone number of the individual responsible for filling and closing the containers. The drums will be marked as Investigative-Derived Waste and will be stockpiled in the designated drum storage area, for subsequent analysis and disposal.

7.2.1.5 Waste Collection Staging Area

A designated waste collection staging area will be established. The location of this area will be coordinated with Northern Division. This area will be used for storage of IDW drums pending results of laboratory analyses and determination of disposal requirements.

7.2.2 Waste Testing

7.2.2.1 Drill Cuttings

The results of laboratory analysis of soil samples will be used to determine if additional data are needed to determine proper disposal. If necessary, individual VOC samples will be collected from each drum. The samples will be shipped to the laboratory where compositing will be conducted prior to analysis. The sample will be analyzed for toxicity characteristic leaching procedure (TCLP) VOC. The remaining parameters will be analyzed from thoroughly mixed composite samples from each drum. The composite samples will be analyzed for the following:

- TCLP Semi-Volatile Organic Compounds (SVOC)
- TCLP Pesticides/PCB
- Alcohols
- TCLP Metals
- Ignitability
- Corrosivity
- Reactivity
- Total petroleum hydrocarbons
- Benzene, toluene, ethylbenzene, and xylene.

Results of sample analyses will be used to make final disposal decisions.

7.2.2.2 Well Development, Purge Water, and Decontamination Fluids

A composite water sample will be collected from the drums and analyzed for the following:

- TCL VOC
- TCL SVOC
- TCL Pesticides/PCB
- TAL Metals
- Flash Point
- Corrosivity
- Reactivity

Results of sample analyses will be used to make final disposal decisions.

7.2.2.3 Other Decontamination Wastes

These materials will not be directly sampled or analyzed, but will be classified as hazardous or non-hazardous under the Resource Conservation and Recovery Act (RCRA), based on the results of the drill cuttings or purge water analyses as appropriate.

7.2.3 Waste Disposal

7.2.3.1 Drill Cuttings and Other Decontamination Wastes

If results of analyses indicate that drill cuttings are not classified as RCRA hazardous wastes, and they are not classified as RCRA-listed wastes, these materials will be disposed by a licensed waste hauler as per Rhode Island Department of Environmental Management residual waste regulations or sent to an appropriate disposal site. If the drill cuttings are considered RCRA-listed or classified waste, they will require offsite disposal as hazardous waste. Ultimate disposal of hazardous waste will be the responsibility of Northern Division.

7.2.3.2 Well Development, Purge Water, and Decontamination Fluids

If results of analyses indicate that waste liquids are not classified as RCRA hazardous waste by classification or by listing, EA plans to discharge the liquid through the RIPA wastewater treatment system through the National Pollutant Discharge Elimination System (NPDES) permitted discharge point provided the liquid meets the RIPA NPDES permit concentration. EA will coordinate this effort with RIPA. If the liquid is considered RCRA-listed or classified waste, offsite disposal at a RCRA-permitted facility will be required. Ultimate disposal of RCRA-listed or classified waste will be the responsibility of Northern Division.

LIST OF FIGURES

APPENDIX B

EA Engineering, Science, and Technology, Inc.

LOG OF SOIL BORING

Co-ordinates: ____________

Surface Elevation: ____________
Casing Above Surface: ____________
Reference Elevation: ____________
Reference Description: ____________

Job No.	Client	Location
Drilling Method:		Boring No.
Sampling Method:		Sheet of

Water Level				Drilling Start	Drilling Finish
Time				Time	Time
Date					
Reference				Date	Date

Surface Conditions:

Sampler Type	Inches Driven / Inches Recovered	Depth of Casing	Sample No. / Sample Depth	HNU (ppm)	Blows/6 In Sampler	Depth in Feet	USCS Log	
						0		
						1		
						2		
						3		
						4		
						5		
						6		
						7		
						8		
						9		
						10		
						1		
						2		
						3		
						4		
						5		
						6		
						7		
						8		
						9		
						0		

Drilling Contractor: ____________ Lic.No. ____________
Driller: ____________

By: B. Blase ____________ Checked By: ____________
Date: ____________

Figure B-1: Soil Boring Log Form

EA Engineering, Science, and Technology, Inc.

LOG OF CORE BORING

Job. No.	Client	Location
Drilling Method:		Boring No.
Core Bit Size:		Sheet of

Coordinates:
Surface Elevation:
Casing Above Surface:
Reference Elevation: Ground Surface
Reference Description:

					Drilling	
Water Level					Start	Finish
Time						
Date						
Reference					hrs.	hrs.

Surface Conditions:

Core Run RCD % No.	Recover % FT	Strati-graphy	Bedding Fract-ures	Fillings	Ova (ppm)	Depth in Feet	Graphic Log	Lithologic Log	Drilling Log
						0			
						1			
						2			
						3			
						4			
						5			
						6			
						7			
						8			
						9			
						10			
						11			
						12			
						13			
						14			
						15			
						16			
						17			
						18			
						19			
						20			

Logged by: Date:

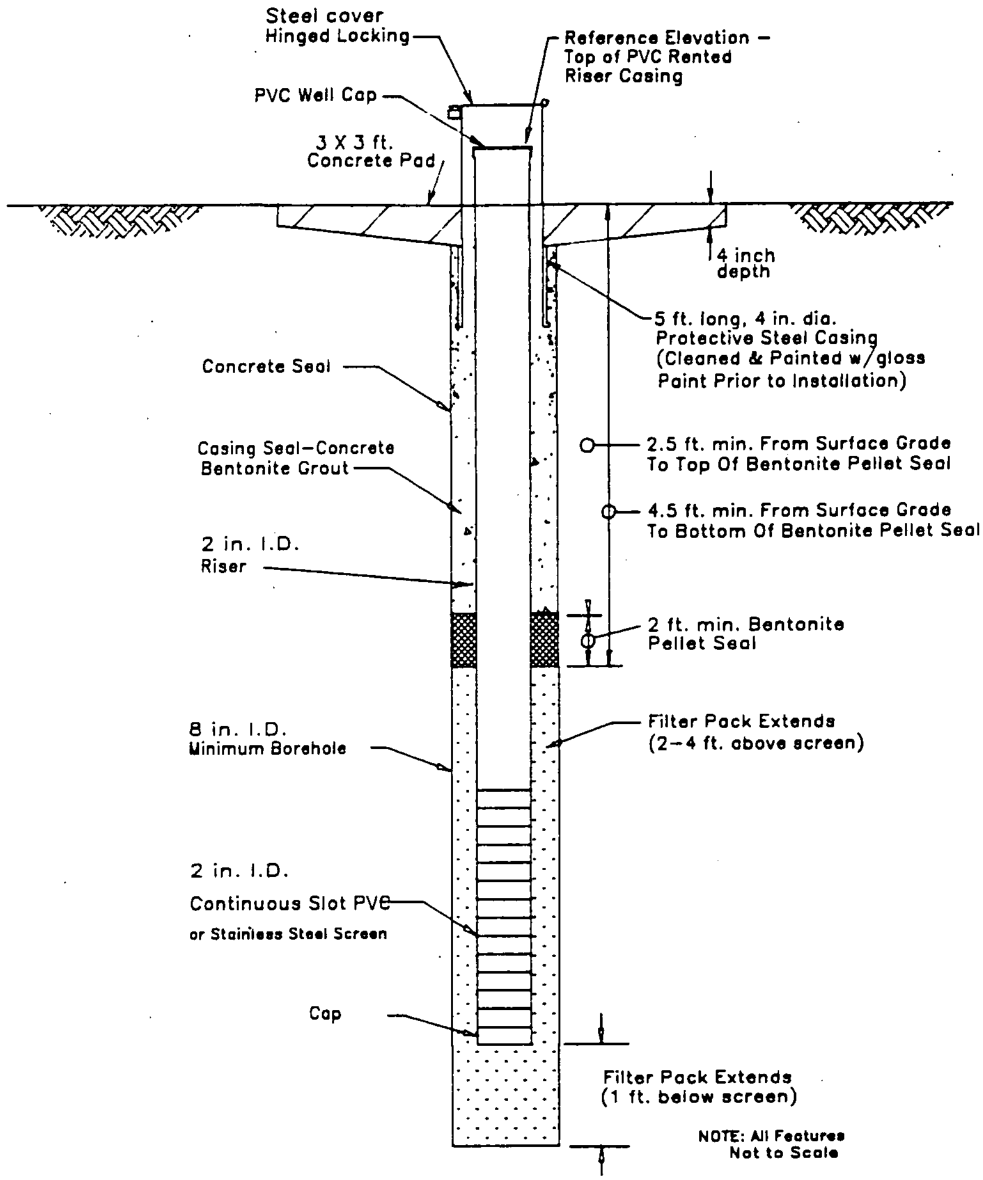
Drilling Contractor: Driller:

WELL SPECIFICATIONS:

Diam. of casing: Screen Interval: Sandpack: Grout:

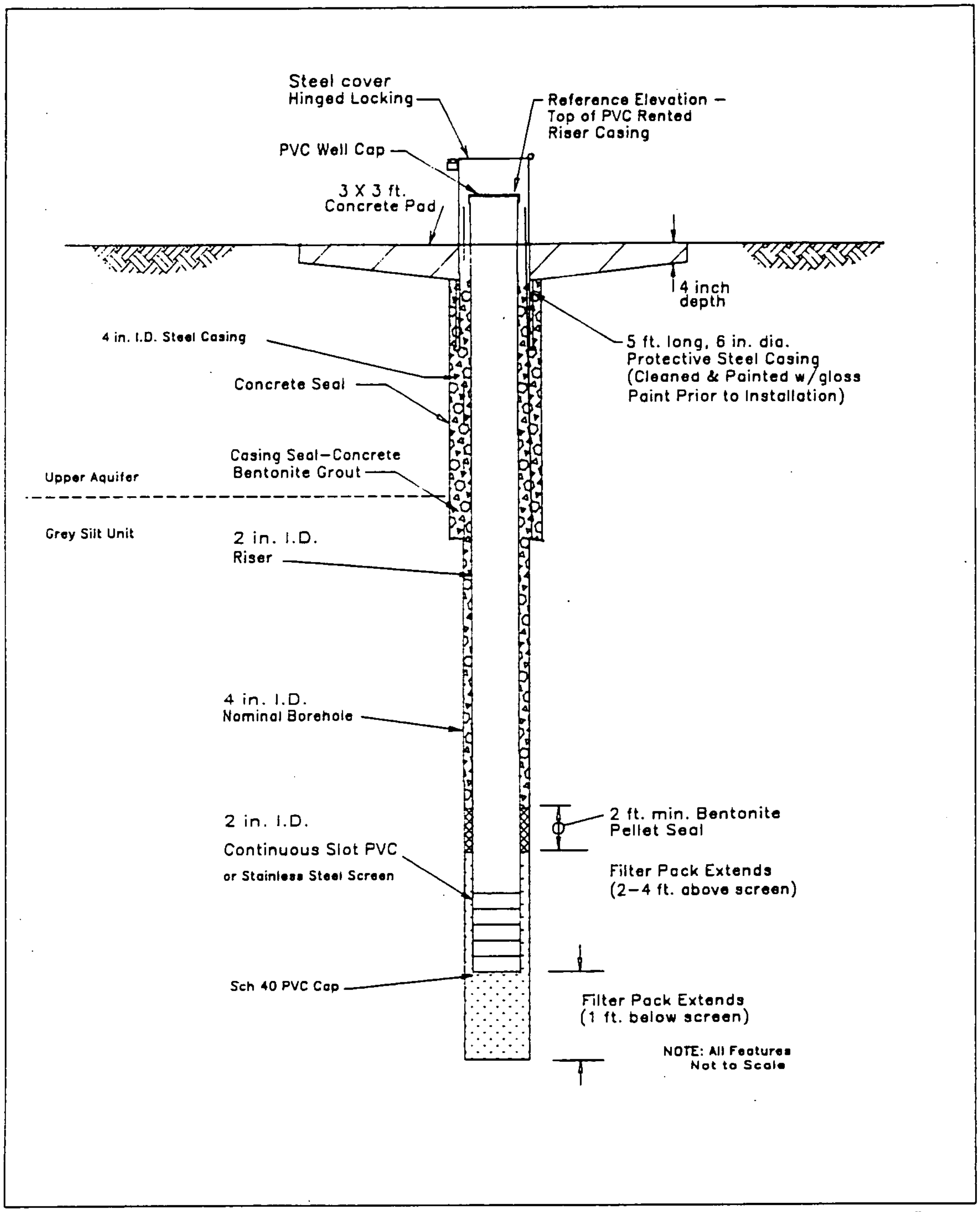
B.O.H.: Riser Interval: Bentonite: Cover:

Figure B-2: Rock Core Log Form



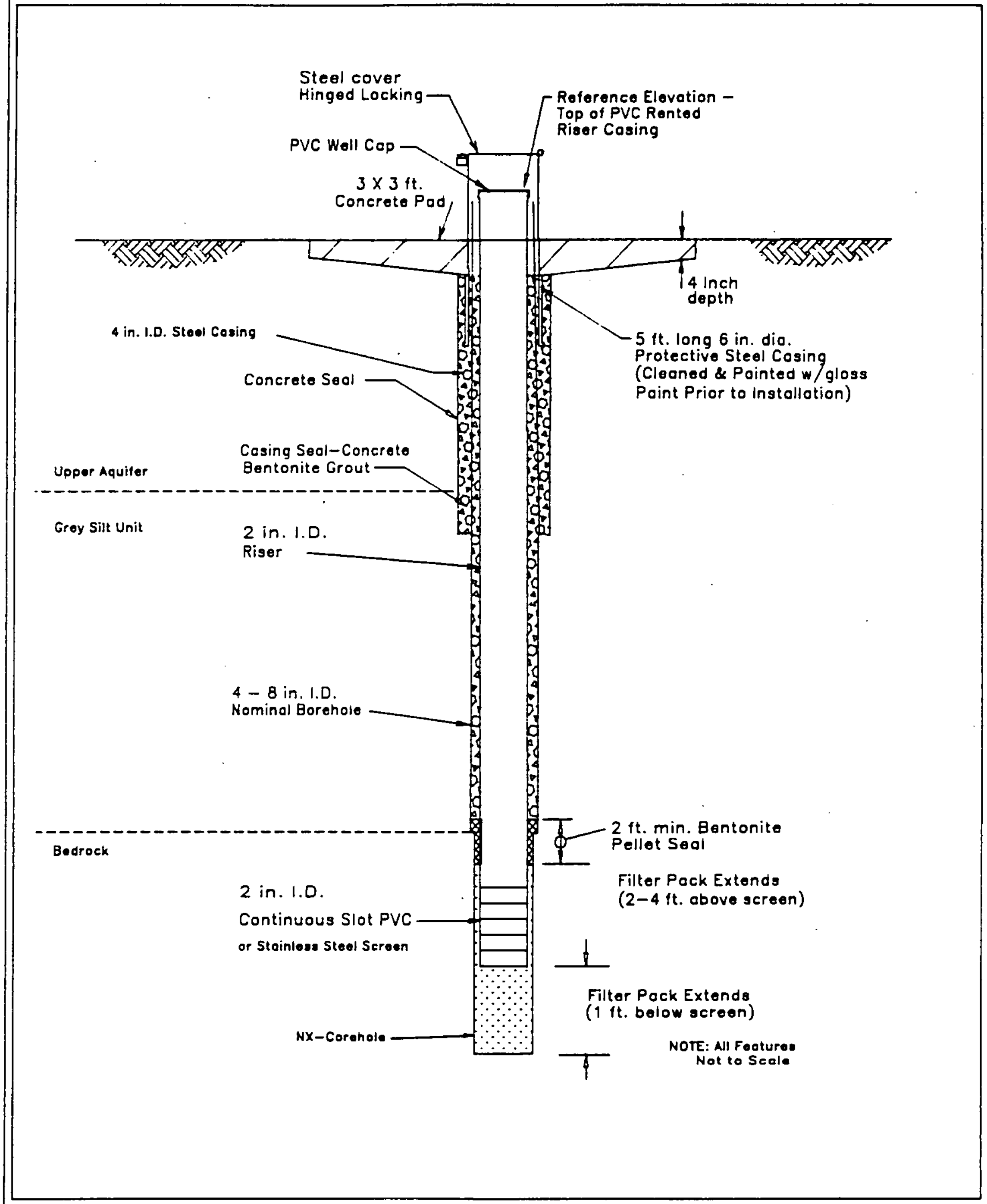
ENGINEERING SCIENCE and TECHNOLOGY	DRAWN BY: JMF	PROJECT NO: 29600.32	PHASE III RI NCBC-DAVISVILLE
	REVIEWED BY: NAL	DATE: 10/24/94	TYPICAL SHALLOW MONITORING WELL COMPLETION DIAGRAM
	APPROVED BY: NAL	SCALE: NA	

Figure B-3: Shallow Monitoring Well Construction Diagram



ENGINEERING SCIENCE and TECHNOLOGY	DRAWN BY: JMF	PROJECT NO: 29600.32	PHASE III RI NCBC–DAVISVILLE
	REVIEWED BY: NAL	DATE: 10/24/94	TYPICAL SILT UNIT MONITORING WELL COMPLETION DIAGRAM
	APPROVED BY: NAL	SCALE: NA	

Figure B-4: Silt Unit Monitoring Well Construction Diagram



ENGINEERING SCIENCE and TECHNOLOGY	DRAWN BY: JMF	PROJECT NO: 29600.32	PHASE III RI — NCBC–DAVISVILLE
	REVIEWED BY: NAL	DATE: 10/24/94	TYPICAL BEDROCK MONITORING WELL COMPLETION DIAGRAM
	APPROVED BY: NAL	SCALE: NA	

Figure B-5: Bedrock Monitoring Well Construction Diagram

EA Engineering, Science, & Technology

WELL DEVELOPMENT FORM

Project Name: ________ Project Number: ________ Task: ________

Site Location: ________

Well Developed By: ________ Title: ________

Drilling Contractor: ________

Name/Description of Disposal Facility: ________

1. **Well Identification Number:** ________
   Date of Installation: ________ Date of Development: ________ Time of Development: ________
2. **Static Water Level:** (in feet)
   Before Development: ________ After Development: ________ 24 Hrs. After: ________
   Total Depth of Well: ________ Quantity of Water Loss During Drilling (If Used) ________ gal.
   Quantity of Standing Water in Well and Annulus Before Development: ________ gal.
3. **Method used for development:** ________
   Equipment type, size and make: ________
   Amount of Time spent on each Method: ________ Pumping rate: ________
4.

	Start:	During:		Finish:
Specific Conductance: (umhos/cm)				
Temperature:				
pH:				
Turbidity: (NTUs)				
Clarity of Water:				

5. **Volume and Physical Character of Water Removed:** ________
   Changes in Water During Development: ☐ Clarity ☐ Color ☐ Particulates ☐ Odor
6. **Volume and Physical Character of Sediment Removed:** ________
   Depth to Top of Sediment: (ft.) Before Development: ________ After Development: ________
   Changes in Sediment During Development: ☐ Color ________ ☐ Odor ________
7. **Volume and Source of Water Added:** ________
   Chemical Analysis of Water Added: ________
8. Screen Length: ________ ft. Height of Well Casing Above Ground: ________ ft.
9. **One Liter Sample Taken** ☐ **Backlit photo taken** ☐ Time: ________ Depth of Sediment in Jar: ________

Development Conditions:
1. Well water is reasonably clear.
2. Sediment Thickness is 5% of screen length.
3. Removal of 5 well volumes, including saturated filter annulus.
4. Stabilization of specific conductance and water temperature.

DAT/MAC: d:\folder\well

Page of page(s)

Figure B-6: Well Development Form

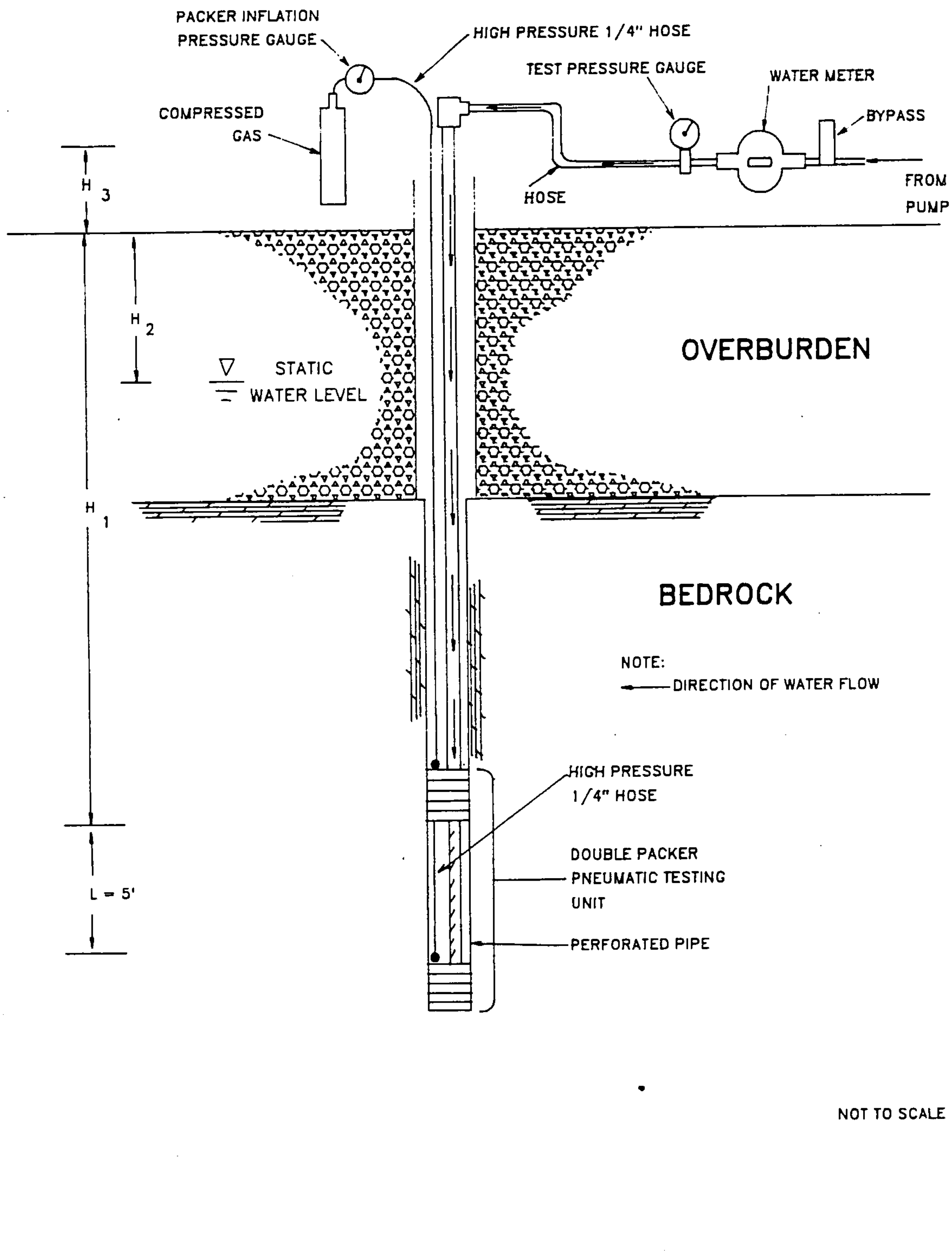


Figure B-7: Typical Packer Test Configuration

	PACKER TEST				Hole No.	Test No.
Project____					Job No. ____	
Client____					Sheet No. ____	
Contractor					Location ____	
	Packer System	Water Meter	Water Gauge	Surge Chamber	Elevation ____	
Type					Date S/F ____	
MFG.					Driller ____	
Model No.					Inspector ____	

M.G.P. = (0.566 to 1.0) x Z____
Computed Max Gauge Pressure: (MGP)____
Computed Internal Friction____

Rock Type____ Hole Size____
Recovery____
RQD (%)____

Depths: (all distances measured from ground surface in feet)

To Top of Rock____
To Bottom of Boring____
To Water Table____

To Top Lower Packer____
To Bottom Upper Packer (Z)____
Length Of Test Section____

Height Of Water Pressure Gauge Above Ground Surface____

Time	Elapsed Time (MIN)	Packer Pressure (PSI)	Gauge Pressure (PSI)	Meter Reading (GALS)	Volume Of Flow (Gals/Min)	Remarks

Figure B-8: Packer Test Data Sheet

Page ___ of ___

Project [ ] Project # [ ] Task [ ] Date [ ]

Sample Location ID [ ] Location Activity [Start: End:]

Water Level/Well Data
☐ Measured ☐ Historical
☐ Top of Well ☐ Top of Prot. Casing ☐ ______
Casing Stick-Up (From Ground) [Ft]
Casing/Well Difference [Ft]

Well Depth [Ft]
Water Depth [Ft]
Height of Water Column [Ft] x

Well Material: ☐ PVC ☐ ______ ☐ SS
Well Locked?: ☐ Yes ☐ No
Well Diameter: ☐ 2 Inch ☐ 4 Inch ☐ 6 Inch ☐ ______
Water Level Equip. Used: ☐ Elect. Cond. Probe ☐ Float Activated ☐ Press. Transducer ☐ ______

☐ .16 Gal/Ft (2 In.)
☐ .65 Gal/Ft (4 In.)
☐ 1.50 Gal/Ft (6 In.)
☐ ___ Gal/Ft (___ In.)
= [Gal/Vol] [Total Gal Purged]

Well Integrity:	Yes	No
Prot. Casing Secure	☐	☐
Concrete Collar Intact	☐	☐
Other ______		

Equipment Documentation

Purging/Sampling Equip. Used:

√ If Used For: Purging	Sampling	Equipment ID
☐	☐ Peristaltic Pump	______
☐	☐ Submersible Pump	______
☐	☐ Bailer	______
☐	☐ PVC/Silicon Tubing	
☐	☐ Teflon/Silicon Tubing	
☐	☐ Air Lift	
☐	☐ Hand Pump	______
	☐ In-Line Filter	
	☐ Press/Vac Filter	
☐	☐ ______	______

Decontamination Fluids Used: (√ All that Apply at Location)
☐ Ethyl Alcohol
☐ Deionized Water
☐ TSP Solution
☐ Hexane
☐ HNO3/D.I. Water Solution
☐ Potable Water
☐ None
☐ ______
☐ ______

Field Analysis Data

Ambient Air VOA [PPM] Well Mouth [PPM] Field Data Collected: ☐ In-Line ☐ In Container

Purge Data	@ ___ Gal	@ ___ Gal	@ ___ Gal	@ ___ Gal	@ ___ Gal
Temperature, Deg C					
pH, units					
Specific Conductivity (umhos/cm. @ 25 deg. c)					
Oxidation-Reduction, +/- mv					
Dissolved Oxygen, ppm					

Sample Observations:
☐ Turbid
☐ Colored
☐ Cloudy
☐ Clear
☐ Odor

Sample Collection Requirements
(√ If Required at this Location)

Analytical Parameter	√ If Field Filtered	Preservation Method	Volume Required	√ If Sample Collected	Sample Bottle ID's
☐	☐			☐	___/___/___/___
☐	☐			☐	___/___/___/___
☐	☐			☐	___/___/___/___
☐	☐			☐	___/___/___/___
☐	☐			☐	___/___/___/___
☐	☐			☐	___/___/___/___
☐	☐			☐	___/___/___/___
☐	☐			☐	___/___/___/___
☐	☐			☐	___/___/___/___
☐	☐			☐	___/___/___/___

Notes:

DAT/MAC fieldfolder

Signature of Sampler: ______

Figure B-9: Field Sampling Form

Chain of Custody Record

EA Laboratories
19 Loveton Circle
Sparks, MD 21152
(410) 771-4920
Fax (410) 771-4407

Company Name:

Project Manager or Contact:

Phone

Project No.

Project Name:

Sample Storage Location:

ATO Number:

Page of

Job ID:

Report/Deliverables:

Parameters/Method Numbers for Analysis*

Date	Time	Water	Soil	Sample Identification 19 Characters	No. of Containers													EA Labs Accession Number	Remarks
																			I.PM.

Sampled by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time
Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	Airbill Number:	Sample Shipped by (Circle) Fed Ex Puro UPS Hand Carried Other

Cooler Temp: ____C **pH:** ☐ **Yes** ☐ **No** **Comments:** **Custody Seals Intact** ☐ **Yes** ☐ **No**

NOTE: Please indicate method number for analyses requested. This will help clarify any questions with laboratory techniques.

WHITE - EA Laboratories YELLOW - EA Laboratories PINK - Project Manager *Shaded Areas for Lab Use Only*

Figure B-10: Chain of Custody Form

EA Engineering, Science, & Technology

COOLER RECEIPT FORM

Project: ______________________ LIMS #: ______________________

Project #: ________ Task: ________ Sender Name: ______________________ Date: ________

A. **Preliminary Examination Phase:** Date cooler opened: __________ C-of-C Number: __________

by (print) ______________________ (sign) ______________________

1. Did Cooler come with a shipping slip (air bill, etc.)? YES NO

   If YES, enter carrier name and air bill number here: ______________________

2. Were custody seals on outside of cooler? YES NO

   How many & where: __________ seal date: __________ seal name __________

3. Were custody seals unbroken and intact at the date and time of arrival? YES NO
4. Did you screen samples for radioactivity using the Geiger Counter? YES NO
5. Were custody papers sealed in a plastic bag & taped inside to the lid? YES NO
6. Were custody papers filled out properly (ink, signed, dated, etc.)? YES NO
7. Did you sign custody papers in the appropriate place? YES NO
8. Was project identifiable from custody papers? If yes, enter project name at the top of this form. YES NO
9. If required, was enough ice used? Type of ice: ______________________ YES NO
10. Designated person shall initial here to acknowledge receipt of cooler: __________ (date) __________

B. **Log-In Phase:** Date samples were logged-in? ______________________

by (print) ______________________ (sign) ______________________

11. Describe type of packing in cooler: ______________________
12. Were all bottles sealed in separate plastic bags? YES NO
13. Did all bottles arrive unbroken & were labels in good condition? YES NO
14. Were all bottle labels complete (ID, date, time, signature, preservative, etc.)? YES NO
15. Did all bottle labels agree with custody papers? YES NO
16. Were correct containers used for the test indicated? YES NO
17. Were correct preservatives added to samples? YES NO
18. Was a sufficient amount of sample sent for tests indicated? YES NO
19. Were bubbles absent in volatile samples? If NO, list by Sample # ______________________ YES NO
20. Was the project manager called and status discussed? If YES, give details on the back of this form. YES NO
21. Who was called? __________ By whom? __________ (date) __________

PLEASE REVIEW OTHER SIDE OF THIS FORM AND NOTE DETAILS CONCERNING CHECK-IN PROBLEMS.

DAT/MAC: cooler/dt folder
Disk: Denise disk 1

Project # ________

Figure B-11: Cooler Receipt Form

DRAFT
WORK/QUALITY ASSURANCE PROJECT PLAN
FOR THE

ECOLOGICAL RISK ASSESSMENT FOR ALLEN HARBOR

24 October 1994

1. **PROJECT NAME:** Ecological Risk Assessment for Allen Harbor

2. **PROJECT REQUESTED BY:** EA Engineering, Science and Technology, Inc.

3. **DATE OF REQUEST:** 24 October 1994

4. **DATE OF PROJECT INITIATION:** August 1994

5. **PROJECT MANAGER:** Dr. Gregory Tracey, SAIC
   PRINCIPAL INVESTIGATORS: Dr. Gregory Tracey, SAIC
   Dr. Wayne Munns, SAIC
   Dr. John King, GSO/URI

6. **QUALITY ASSURANCE OFFICER:** Mr. Timothy Gleason, SAIC

CONTENTS PAGE

7. PROJECT DESCRIPTION

7.1 INTRODUCTION

The purpose of work identified in this Work Plan is to fill data gaps in the information base required to conduct ecological risk (ecorisk) assessments and satisfy long term monitoring requirements for hazardous waste disposal sites located at the Naval Construction Battalion Center Davisville-Disestablished (NCBC) in Narragansett Bay, Rhode Island. The procedures and data collection activities identified in this Work Plan have been developed following the general approach outlined in the draft Work/Quality Assurance Project Plan (W/QAPjP) for Narragansett Bay Ecorisk and Monitoring for Navy Sites (URI and SAIC, 1994) as ammended based on incorporation of EPA review comments (Miniuks 1994). The Davisville-Quonset Point study area including Allen Harbor, Calf Pasture Point, and associated reference areas in the West Passage of Narragansett Bay have been identified as a specific study area in the Narragansett Bay Ecorisk Work Plan.

The focus of this Work Plan is on assessment of the potential significance of exposure and ecological effects of contaminants escaping from the landfill at NCBC Davisville-Quonset, including additional data gathering activities with regard to the discharging of seepwater into the sediment and up through the bottom of the harbor to biologically active zones.

This document is formatted as a combined Work/Quality Assurance Project Plan (W/QAPjP), and is intended to be a site-specific addendum to the Narragansett Bay Ecorisk Study (NBES). Included here are project specific modifications/additions to the NBES, including descriptions of salient Quality Assurance/Quality Control (QA/QC) considerations and protocols which will be employed to ensure that the data and information collected in this project are of known quality. Similar formats were used in previous marine and estuarine ecological risk assessments conducted for the Navy in Allen Harbor at NCBC (NOSC and ERLN 1990; ERLN/NOSC 1991), and for Portsmouth Naval Shipyard, Kittery, ME (ERLN and NOSC 1991; NCCOSC/ERLN 1992; NCCOSC, ERLN, and UNH 1993).

7.2 BACKGROUND

The Naval facility at NCBC is located in the lower West Passage of Narragansett Bay (Figure 1). The site is on the National Priorities List (NPL), and a Federal Facility Agreement is in place. NCBC is being closed under Base Reutilization and Closure (BRAC) procedures and must comply with requirements specified under the Comprehensive Environmental Resource Compensation and Liability Act (CERCLA), the National Contingency Plan (NCP), and Rhode Island State Statues. These Federal regulations mandate the assessment of the risk of hazardous waste disposal sites on human health and the environment and to identify appropriate cleanup levels (Johnston and Nixon 1994). There is an extensive amount of data and information on Allen Harbor resulting from the Risk Assessment Pilot study Phases I, II and III (Munns, et al., 1991, 1992, 1994). These data will be used to augment information obtained in the present study for completion of the ecological risk assessment. The technical data and information developed during this study will provide the information needed to satisfy specific regulatory requirements and to identify remedial options which are based on a sound understanding of ecological processes of Narragansett Bay and adjacent waters.

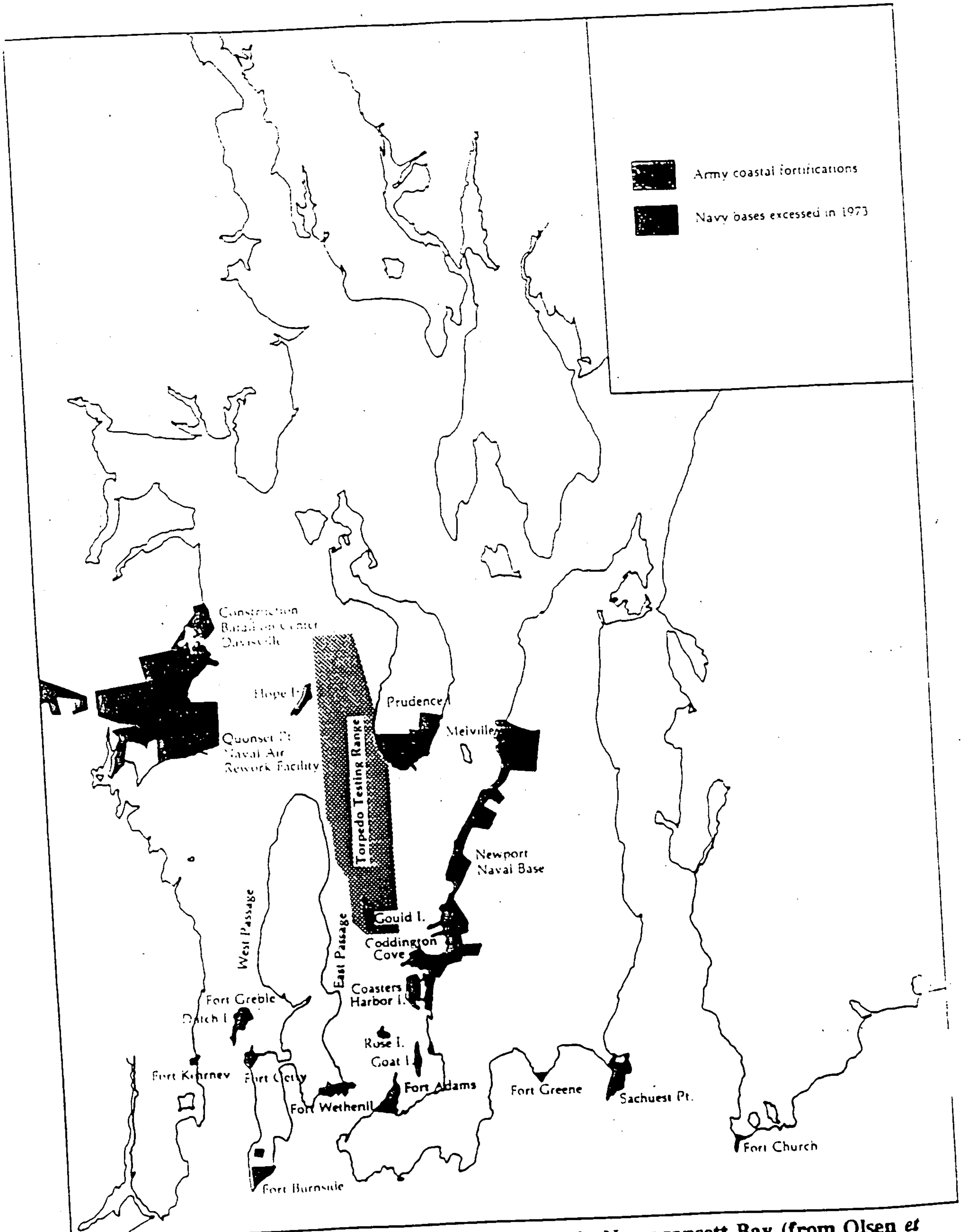


FIGURE 1. Navy bases and coastal fortifications in Narragansett Bay (from Olsen *et al.* 1980).

7.3 OBJECTIVES, SCOPE, AND DATA USAGE

The objective of this investigation is to assess potential ecological risk of contaminant seepage from upland sites at NCBC Davisville on the ecology of Allen Harbor. EPA's Ecological Risk Assessment Framework and applicable EPA Region I guidance documents were consulted to design the data collection activities of this study. Existing data and information Allen Harbor and Narragansett Bay will be incorporated to complete the ecological risk assessment. This W/QAPjP provides a summary of site characterization information, an initial problem formulation declaration, a plan for data collection and analysis, a plan for risk characterization, and a project schedule for completion.

7.4 TECHNICAL APPROACH

This project will be implemented following guidance provided by the U.S. EPA Risk Assessment Forum's "Framework for Ecological Risk Assessment" (USEPA 1992; Norton *et al.* 1992). The framework is intended primarily to provide a logical overarching structure for conducting risk assessments, and to enhance uniformity among assessments. The site-specific risk assessment protocols proposed here builds upon techniques and methods applied for previous marine and estuarine ecological risk assessment case studies performed at NCBC Davisville and at the Naval Shipyard Portsmouth, Kittery, Maine (NOSC and ERLN 1990; Johnston *et al.* 1990; Munns *et al.* 1991, 1992, 1994; Mueller *et al.* 1992; Johnston and Nixon 1994). Further details on the theory and background of the risk assessment approach are contained in URI and SAIC (1994).

The risk assessment framework to be implemented for Allen Harbor consists of three major components; *Site Characterization/Problem Formulation*, *Data Collection/Analysis* and *Risk Characterization*. The general scope of activities germane to each component are described in URI and SAIC (1994) and are consistent with EPA's ecological risk assessment framework.

Site Characterization/Problem Formulation. The Site Characterization/Problem Formulation component for this study involves a synopsis of existing data for Allen Harbor and nearby Narragansett Bay and will result in a conceptual model of ecological risks at the site. Substantial information is available regarding the biology, chemistry, and physical characteristics of Allen Harbor and the Lower West Passage study area. The NCBC Phase I, II and III reports, in conjunction with data collected in this study, will provide a context within which to assess marine ecological risks associated with contamination in Allen Harbor. An overview of the Problem Formulation Plan is outlined in URI and SAIC, 1994; section 7.4.3, and will build upon the Phase I problem formulation for NCBC (Munns *et al.*, 1991).

A first tier conceptual model of stressor transport and fate is presented in Figure 2, based on results of the Phase I pilot study (Munns *et al.*, 1991). Preliminary elements of the model include: 1) chemical stressors from the landfill enter Allen Harbor primarily via seep water; 2) the sediments are proximal sinks for contamination, 3) sediment quality issues are of primary concern, 4) ecological risks appear constrained to the Harbor but may extend to nearby Narragansett Bay, and 5) additional sources of chemical, pathogen and nutrient stress are also present. A complete synopsis of these problem formulation components will be presented in the final risk assessment document.

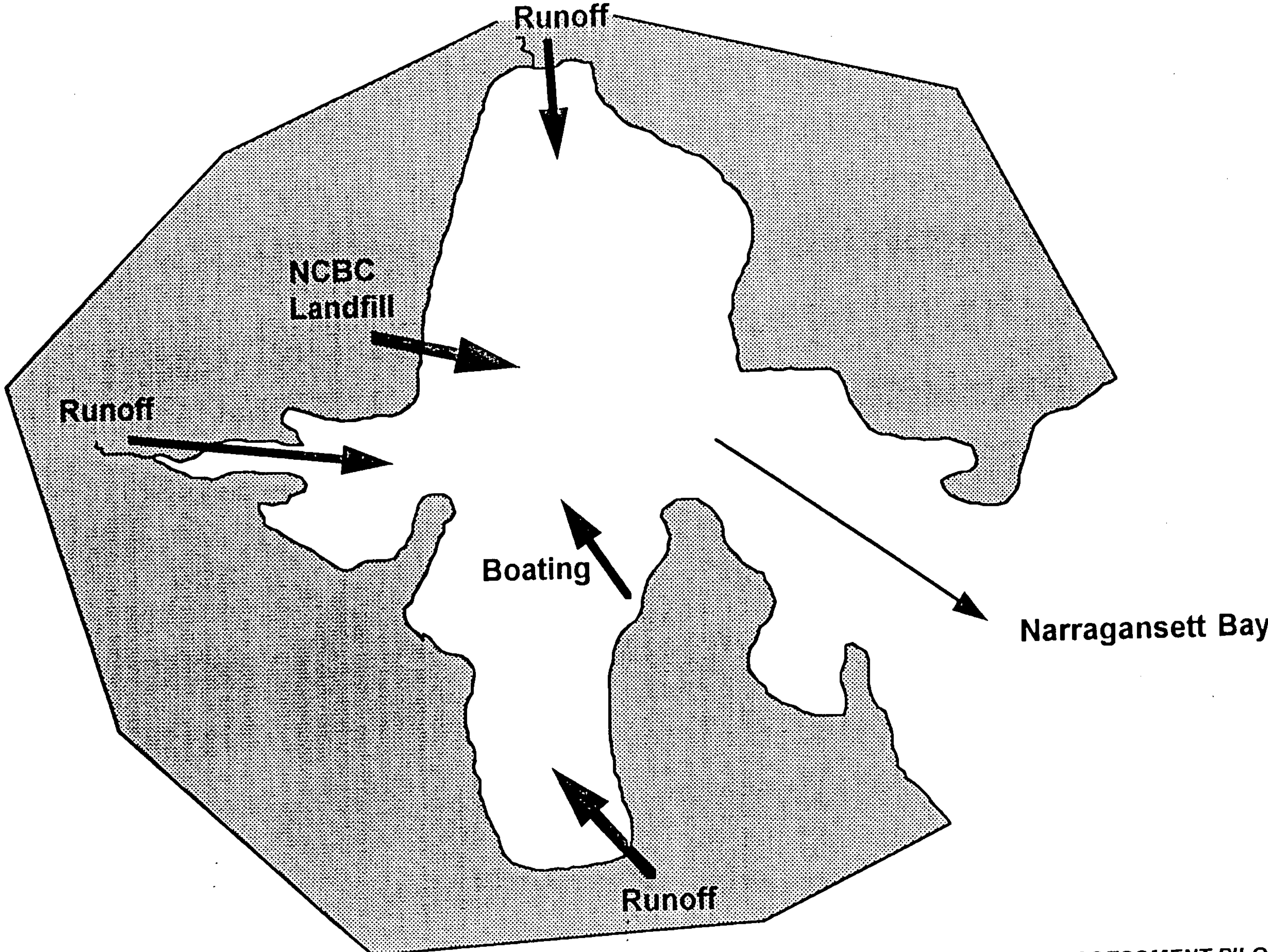
Data Collection/Analysis Previous and ongoing Problem Formulation activities have identified additional data needs including assessment of chemical contamination and toxicity at marsh/wetland sites and nearby harbor sites as well as sampling of indigenous biota for chemical body burden, abundance and size distribution. A series of 10 marsh/wetland and 10 deep sediment cores will be taken to further address issue of potential chemical exposure and ecological effects of groundwater seepage from the landfill on Allen Harbor wetland and marine environments. The exact locations of stations within each sampling area will be established following initial field reconnaissance. Details of the sediment collection plan are described in section 7.5. In addition, biota samples will be collected in the wetland areas at locations close to sediment sampling stations. Those species which, ultimately, are collected will be subject to availability but are expected to include the quahog, *Mercenaria mercenaria*, the blue mussel, *Mytilus edulis*, the ribbed mussel, *Modiolus demissus*, the soft shell clam, *Mya arenaria* and mummichogs (*Fundulus* spp.). Details of the organism collection and analysis are summarized in section 7.6. Among the suite of available samples, fifteen (15) species specific composite samples will be selected for chemical analyses based on number, biomass and spatial distribution.

Data analysis activities will focus on describing exposure characteristics and potential ecological effects based on new and existing data as identified in the Narragansett Bay Ecorisk Work Plan (URI and SAIC, 1994). Exposure characterization, for example, will involve the quantification of stressor (e.g. chemical) distribution in relation to receptors (e.g. observed body burden in bivalve tissues). Similarly, effects characterization will involve exposure (metals concentration) - response (toxicity to *Arbacia punctulata*) analysis of porewater. In addition, the pore water and sediment chemistry data will be compared with sediment and water quality criteria, LC 50 values, etc. Full details of data collection and analysis activities will be summarized in the final ecorisk report.

Risk Characterization The plan for risk characterization will follow methods and procedures outlined in URI and SAIC, 1994. The final step of ecological risk assessment involves synthesis of the exposure and ecological effects information to determine the likelihood of occurrence of adverse ecological effects. Several

FIGURE 2. First Tier Conceptual Model of Stressor Transport and Fate.

FIRST TIER CONCEPTUAL MODEL
Stressor Transport and Fate



approaches will be used to characterize ecological risks associated with Navy disposalsites in Allen Harbor. These range from screening approaches such as the calculation of the qualitative risk (or hazard) quotients, to more quantitative analyses involving exposure-response models for sediments and pore water. Each of these approaches are described in URI and SAIC (1994), and include 1) *comparisons with reference stations*, 2) *risk quotients,* 3) *bioaccumulation and trophic transfer, and* 4) *joint probability of exposure and response models*, as appropriate.

7.5 SEDIMENT SAMPLE COLLECTION

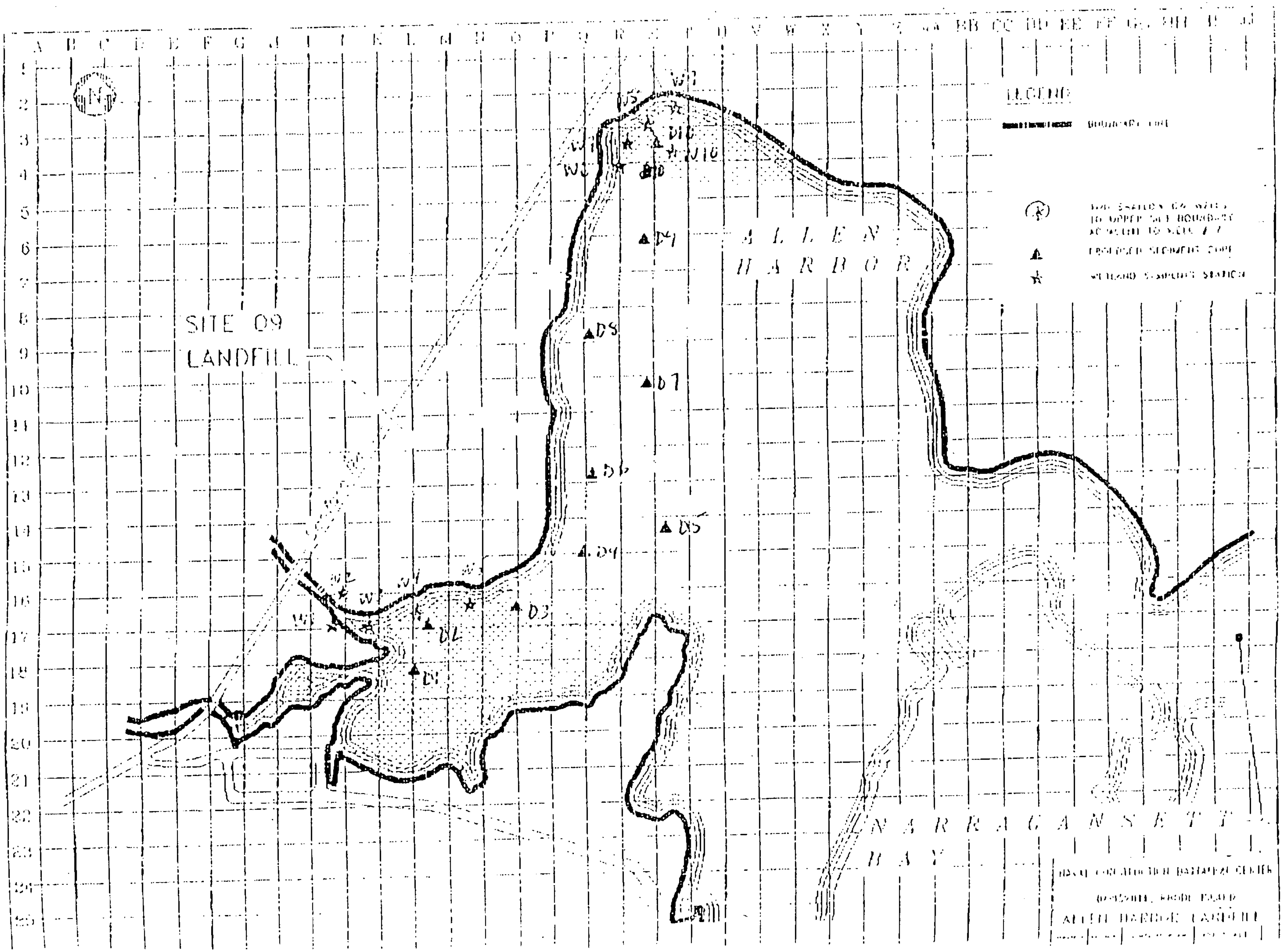
Samples to be collected for analysis in this project include surface grabs and 1-m deep cores at stations identified in Figure 3 and Table 1. In addition a reference station will be selected after review of NCBC Phase I, II and III data reports. All samples will be collected and processed following the SOP described in Appendix B of URI and SAIC (1994) and Mueller *et al.* (1992). Surficial (0-2 cm) sediment samples will be obtained from replicate box cores at each station. Subsamples from each replicate will be composited for chemical, physical, and toxicological assessment. The complete list of chemical analytes to be measured in this study is provided in Table 2, along with their respective detection limits. Analysis of metals in sediments and biota will be performed by URI under subcontract to SAIC. (Analysis of sediments and tissues for organic contaminants will be carried out under separate contract by EA).

Surface Box Cores. The purpose of the box coring is to develop information on chemical contaminant levels and toxicity of chemicals present within the wetland sediments. These data will be used to assess surface water as a route for the transport of chemicals and as a site for contaminant exposure and ecological effects. In addition, bioavailability and exposure-response information will be evaluated by chemical and biological analysis of interstitial water extracted from a subset of samples from the most contaminated/impacted stations.

At each station, three replicate box cores will be collected, from which the top 2 cm of sediment will be collected. Sample materials will be composited in the field and subsampled for sediment toxicity bioassays (using *Ampelisca* or other appropriate amphipod species), pore water toxicity tests (using *Arbacia*), analysis of SEM/AVS, Grain size and TOC determinations, and bulk chemistry analysis.

Deep Cores. The purpose of the deep cores is to assess sub-surface sediment contamination and toxicity. Four replicate cores about 1-2 m in length will be collected at appropriate locations within Allen Harbor (Figure 3). Each replicate core will be scanned for magnetic susceptibility to determine the representative core (for each sampling area) to be selected for determination of chemical contamination and toxicity. Replicate cores will be sectioned at appropriate horizons and composited for analysis of bulk metals, organic contaminants, grain size, total organic carbon.

FIGURE 3. Sampling locations in the Allen Harbor study area.



SITE 09
LANDFILL
ALLEN
HARBOR
NARRAGANSETT
BAY
LEGEND
WETLAND SAMPLING STATION
ALLEN HARBOR LANDFILL
D1
D2
D3
D4
D5
D7
D8
D9

Deep cores are collected using a piston corer. The standard piston corer utilizes polycarbonate tubes as core barrels and is deployed using a series of 3-m long extension rods to push the corer into the sediment column. Cores 10 cm in diameter and 0.8–1.0 m long are obtained with this method. Cores are stored vertically after retrieval and are incrementally subsampled (at a 1–2 cm interval) by extruding the core out of the top of the core tube using a piston placed in the bottom of the tube and an extrusion box marked at 1 cm intervals. Subsamples are frozen and stored until laboratory analysis.

Interstitial water samples will be obtained from the upper 5 cm of the sediment column utilizing the syringe extraction method of Winger and Lasier (1991). The interstitial water samples can be obtained from both the grab and core samples. The method involves insertion of a glass-bead air stone into the sediment attached to silastic tubing. The other end is connected to a 50 cc syringe, to which suction pressure is applied. A 50 ml particulate-free sample is collected over a period of 8-16 hr, under refrigeration. This method has the advantage of minimizing aerial exposure, such that volatile compounds and other *in situ* characteristics of the sample are retained. The interstitial water samples will be analyzed for metals concentration, as well as toxicity using the *Arbacia punctulata* bioassay.

TABLE 1. **Sampling areas, station locations, and site positions for the study areas in Allen Harbor.**

Sampling Area		Station	(x, y) Position[a]	Comment
AHW	Allen Harbor Wetland	AHW1		Western Wetland
		AHW2		Western Wetland
		AHW3		Western Wetland
		AHW4		Western Wetland
		AHW5		Western Wetland
		AHW6		Northern Wetland
		AHW7		Northern Wetland
		AHW8		Northern Wetland
		AHW9		Northern Wetland
		AHW10		Northern Wetland
AHD	Allen Harbor Deep	AHD1		Nearshore Transect
		AHD2		Nearshore Transect
		AHD3		Nearshore Transect
		AHD4		Nearshore Transect
		AHD5		Nearshore Transect
		AHD6		Nearshore Transect
		AHD7		Nearshore Transect
		AHD8		Nearshore Transect
		AHD9		Nearshore Transect
		AHD10		Nearshore Transect
REF	Reference Station	REF		To be selected

[a] To be determined upon final station positioning.

TABLE 2. Target analytes for chemical characterization.

Analyte		Sample matrix	Target detection limit[a]
Polycyclic Aromatic Hydrocarbons (PAHs)		sediment	1-5 ng/g
		water	1-5 µg/L
naphthalene	fluoranthene	biota	5-10 ng/g
2-methylnaphthalene	pyrene		
1-methylnaphthalene	benz[a] anthracene		
biphenyl	chrysene		
2,6-dimethylnaphthalene	benzo [b] fluoranthene		
acenaphthylene	benzo [k] fluoranthene		
acenaphthene	benzo [e] pyrene		
1,6,7-trimethylnaphthalene	benzo [a] pyrene		
fluorene	perylene		
phenanthrene	indeno [1,2,3-cd] pyrene		
anthracene	dibenz [a,h] anthracene		
1-methylphenanthrene	benzo [ghi] perylene		
Organo-Chlorine Pesticides (OCPs)		sediment	1-2 ng/g
		water	1-2 µg/L
Aldrin		biota	1-2 ng/g
hexachlorobenzene			
Mirex			
o.p' - DDE			
p.p' - DDE			

TABLE 2. (continued)

Analyte	Sample matrix	Target detection limit[a]
Polychlorinated Biphenyl (PCB) Congeners	sediment	1-2 ng/g
	water	1-2 µg/L
8 (2 4')	biota	1-2 ng/g
18 (2 2'5)		
28 (2 4 4')		
52 (2 2'5 5')		
44 2 2'3 5')		
66 (2 3'4 4')		
101 (2 2'3 5 5')		
118 (2 3'4 4'5)		
153 (2 2'4 4'5 5')		
105 (2 3 3'4 4')		
138 (2 2'3 4 4'5)		
187 (2 2'3 4'5 5'6)		
128 (2 2'3 3'4 4')		
180 (2 2'3 4 4'5 5')		
170 (2 2'3 3'4 4'5)		
195 (2 2'3 3'4 4'5 6)		
206 (2 2'3 3'4 4'5 5'6)		
209 (2 2'3 3'4 4'5 5'6 6')		
Major elements		
aluminum	sediment	0.18 µg/g
	water	75 µg/L
	biota	0.18 µg/g
iron	sediment	0.5 µg/g
	water	20 µg/L
	biota	0.5 µg/g
manganese	sediment	0.01 µg/g
	water	0.5 µg/L
	biota	0.01µg/g

TABLE 2. (continued)

Analyte	Sample matrix	Target detection limit[a]
Trace elements		
copper nickel chromium lead silver	sediment water biota	0.01-0.7 µg/g 0.5-3 µg/L 0.01-0.7 µg/g
cadmium	sediment water biota	0.05 µg/g 0.2 µg/L 0.005 µg/g
zinc	sediment water biota	0.003 µg/g 0.1 µg/L 0.003 µg/g
arsenic	sediment water biota	0.08 µg/g 3 µg/L 0.08 µg/g
mercury	sediment water biota	0.125 µg/g 5 µg/L 0.125 µg/g
Butyltins	sediment biota	1 ng Sn/g 1 ng Sn/g
monobutyltin dibutyltin tributyltin		

[a] Sediments and tissues measured on a dry weight basis.
[b] congener number (position of chlorines)

7.6 ORGANISM COLLECTION AND MAINTENANCE

Organisms to be collected for toxicological investigations in this project include the benthic amphipod *Ampelisca abdita* (or other appropriate amphipod species) for sediment toxicity assessments, and the sea urchin, *Arbacia punctulata*, for pore water toxicity assessments. All animals will be collected and maintained following protocols described in Mueller *et al.* (1992).

A variety of indigenous biota samples will be collected to evaluate specific measurement endpoints for bioaccumulation and direct exposure to the chemicals of concern. The species have been selected to represent a range of ecological functions (trophic, phyletic, interaction, *etc.*) within the ecosystem, as well as being components of commercially important aquatic resources in Narragansett Bay. The biota data will also be used to evaluate trophic transfer of contaminants and to assess the potential impact to human health from seafood consumption. Based on the habitat type present and the availability of organisms at the sampling locations the following species will be collected: quahogs (*Mercenaria mercenaria*), mussels (*Mytilus edulis* or *Modiolus demissus*), soft shell clams (*Mya arenaria*), and mummichogs (*Fundulus* spp.). Estimates of abundance, and distribution within the study area will be developed for each of the species based on field observations and historical data. Tissue samples will be shipped to a laboratory designated by EA to be processed for organic chemical analysis and lipid content and will be analyzed by URI for metal content. Condition indices will be evaluated for all bivalve species, soft shell clams will be evaluated for the presence of hematopoietic neoplasia (Hn) after URI and SAIC (1994), and mummichogs will be inspected for external evidence of pathological damage (fin rot, gill lesions, *etc.*).

7.7 MONITORING PARAMETERS AND FREQUENCY OF COLLECTION

Parameters for bioassay methods for the *Ampelisca* assay and the *Arbacia* assay will follow procedures outlined in URI and SAIC (1994).

8. SCHEDULE OF TASKS AND PRODUCTS

The schedule of task activities and deliverable products associated with this project will be:

1. **Final Work/Quality Assurance Project Plan**: Provides project overview, documents validity of data gathering and analysis approaches, and provides information on project organization and delivery schedule.

   1.5 months from receipt of comments on Draft Work Plan

3. **Initiation of Technical Activities**: Currently assumed to be 15 November 1994. **Upon receipt of Tasking from EA Engineering**

4. **Completion of Technical Activities**: Currently projected for 15 January 1995. **2 months following initiation of technical activities**

5. **Draft Final Project Report**: Provides project overview, describes Problem Formulation, Analysis, and Risk Characterization methods and results in draft, currently projected for 3/15/95.

   2 months following competition of technical activities

6. **Final Project Report**: Provides project overview, describes Problem Formulation, Analysis, and Risk Characterization methods and results in final form.

   1 month from receipt of comments on Draft Project Report

7. **Final Data Dump**: Provides all quality assured data obtained during investigations in ASCII format.

   At project completion

The schedule indicated above is tentative and wholly dependent upon the date of receipt of tasking from EA for initiation of project technical activities. SAIC is currently assuming that tasking will be received by 15 November 1994 time frame, and that sufficient funding will be available for timely completion of project activities and products.

In addition to the deliverables identified above, project personnel will provide technical support and input to the NCBC Technical Review Committee (TRC) at the request of EA. Input to the TRC, in the form of technical briefings, will be conducted on a biannual basis, or more frequently as appropriate. Briefing packages containing materials presented at TRC meetings will be provided to EA for distribution.

Unless negotiated differently with EA all deliverables will be prepared in a format identified by SAIC. Project reports will contain, at a minimum, Executive Summary, Introduction, Methods, Results, and Discussion sections. Referenced literature citations and appendices will be included as appropriate.

9. PROJECT ORGANIZATION AND RESPONSIBILITY

Section 9.1 below identifies key personnel and responsibilities specific to this project. This discussion focuses upon the primary responsibilities of individuals directly involved in project planning, management, and execution.

9.1 PROJECT MANAGER

Dr. Gregory Tracey, SAIC is the Project Manager and a Principal Investigator for this project. He has general management and QA/QC oversight of all activities associated with the EA subcontract to SAIC. In this capacity, he will conduct the following activities:

- Review progress of technical activities towards attainment of project goals
- Review technical products and deliverables for quality and conformance to technical objectives of the project
- Participate in project technical activities to the extent warranted by skills and task requirements
- Communicate with EA on issues relating to definition and conduct of project tasks, inform the EA Project Manager of project status, and ensure the transmission of all deliverables to the EA Project Manager
- Ensure that the project is appropriately organized with effective lines of communication, and that project responsibilities and authorities for making critical decisions are clearly understood

9.2 PROJECT QUALITY ASSURANCE OFFICER

The Project Quality Assurance Officer, Mr. Timothy Gleason, will be responsible for ensuring compliance to all project QA/QC objectives, and for communicating compliance status to Dr. Tracey. Mr. Gleason will perform the following specific tasks:

- Provide guidance in the preparation of the W/QAPjP
- Perform technical review of the W/QAPjP and ensure that project QA/QC procedures are adequate for meeting data quality objectives
- Conduct performance and systems audits to ensure compliance with project QA/QC procedures
- Identify and report QA/QC deficiencies to Dr. Tracey
- Recommend appropriate corrective actions when a QA/QC deficiency is identified, and ensure that corrective measures are implemented effectively
- Review and approve all products and deliverables of the project
- Review documentation of all QA/QC activities that occur throughout the period of performance of this project

9.3 PROJECT PRINCIPAL INVESTIGATORS

The Principal Investigators for this project have been selected for participation in this project based upon a number of criteria, including technical skill, experience, and existing commitments to other projects. Their responsibilities include oversight of all scientific activities in support of objectives of the project, conformance to all QA/QC requirements, and communication with Dr. Tracey and other Principal Investigators on issues of technical effort status, progress, and problems. Principal Investigators also will be responsible for communicating options regarding technical approach within their area of expertise. In addition to Dr. Tracey, the Principal Investigators associated with this project are:

- Dr. Wayne Munns, Senior Scientist and Manager of Science Applications International Corporation's (SAIC) Applied Aquatic Sciences Division. Dr. Munns is an expert in ecological risk assessment, and is trained as a marine ecologist. He served as the Principal Investigator for the Allen Harbor and Portsmouth Naval Shipyard marine ecological risk assessment case studies, as well as other risk assessments of contaminant effects on marine and estuarine systems.

- Dr. John King, Associate Professor of Oceanography, University of Rhode Island. Dr King's expertise is the geochemistry of marine and estuarine sediments. Dr. King will be responsible for project planning and reporting, trace metals analyses, and geotechnical characterizations of sediments.

10. DATA QUALITY REQUIREMENTS AND ASSESSMENTS

Of obvious importance to all measurement and monitoring projects (*i.e.*, data generating activities) is the establishment of objectives for data quality based upon the proposed uses of the data (Stanley and Verner 1983). A primary purpose of a quality assurance program is to maximize the probability that the resulting data will meet or exceed the DQOs specified for the project. Normally, DQOs are established in terms of five aspects or attributes of data quality: precision, accuracy, completeness, representativeness, and comparability (Stanley and Verner 1983). A complete description of these components are described in section 10 of URI and SAIC (1994).

11. ANALYTICAL PROCEDURES

The sediment and porewater metals analyses required for this study will be conducted by Dr. King of GSO/URI under subcontract to SAIC. A complete description of the GSO/URI procedures is included in URI and SAIC (1994). Organics analysis and associated QA/QC activities will be managed in whole by EA Engineering. Quality Control Procedures for metals analysis of tissues and sediments will be conducted as described in Section 11 of URI and SAIC (1994).

12. SAMPLE CUSTODY PROCEDURES

All samples, whether generated in the laboratory or field, will receive a unique sample number generated and tracked by Mr. Gleason. This number will be affixed to sampling containers, and pertinent collection information (station, date, time, depth, *etc.*) will be entered into sampling logs by field personnel. This information will be transferred to data bases as described in the draft Data Management Plan (URI and SAIC, 1994; Appendix D). Duplicate logs will be maintained to minimize loss of information.

Because different individuals may be involved in the collection and distribution of individual samples, chain-of-custody forms will be maintained for each set of samples transferred. These forms will follow each set of samples from collection through sample archiving. Duplicate forms will be maintained to minimize loss of information. Sample condition will be evaluated by the appropriate project staff at time of receipt from field collection personnel.

Samples for physical and biological analysis will be stored prior to analysis as described in relevant SOPs (URI and SAIC 1994; Appendix B; Mueller *et al.* 1992). Samples for chemical analysis will be stored on ice during transport to the laboratory (URI) and frozen at -20°C (tissue chemistry) or refrigerated at 1-5°C in the dark (sediments) prior to shipment.

13. CALIBRATION PROCEDURES AND PREVENTIVE MAINTENANCE

SOPs contained in Appendix B of URI and SAIC (1994) and Mueller *et al.* (1992) describe the methods used for calibrating and maintaining all essential equipment to be used in this project.

14. DOCUMENTATION, DATA REDUCTION AND REPORTING

Raw biological assessment data collected by SAIC personnel will be entered directly onto test-specific standardized data sheets and log books. Examples of raw data sheets are provided in Mueller *et al.* (1992). Duplicate copies will be maintained to minimize loss of information. The raw data also will be entered into computerized data bases (as described in the draft Data Management Plan). Transcription errors will be minimized by a two level check: personnel responsible for data entry will review each record for errors, and a second individual will check 10% of all entries. Identified errors will be corrected immediately. If transcriptions errors are observed at a rate greater than 2%, all data entered will be rechecked.

Test-specific data reduction practices and statistical analyses are described in Mueller *et al.* (1992). Generally, data reduction and statistical analyses will be performed by computerized utilities (*e.g.*, SAS). Statistical analysis approaches will be reviewed by a professional statistician with SAIC.

Final data reports will be prepared for the project Principal Investigators upon completion of biological assessment data validation and analysis. These reports will contain descriptions of test conditions, results, and ancillary observations, and may contain preliminary interpretations. Additionally, raw data will be accessible through centralized data bases and data sheets.

15. DATA VALIDATION

All raw and computerized data reported by SAIC in this project will be subjected to a 100% review by the personnel responsible for each assessment. An additional review will be performed by a second individual to identify errors in recording, transcription, and reporting. Raw data sheets and laboratory notebooks will be reviewed in this process. Data that do not meet the standards described in this document will be reported with an explanatory notation. The Principal Investigators will make the final determination as to data validity. Descriptions of interpretation and synthesis activities utilizing suspect data will be prefaced with an explanation of data quality.

16. PERFORMANCE AND SYSTEMS AUDITS

Audits of all project activities may be performed by the EA and SAIC Quality Assurance Officers at any time over the course of this project. Such audits will compare QA/QC activities actually performed with those identified in this W/QAPjP. These audits may involve site visits, direct observations of technical performance, review of all levels of data documentation, review of field logs and chain-of-custody procedures, and QA/QC review of reports and products. Full cooperation will be extended by project staff to either QA Officer during such audits to facilitate identification of non-compliance and to enhance the quality of data generated through conduct of work assignment activities. Results of audits will be reported to the EA Project Manager and Dr. Tracey. After consultation, Dr. Tracey will develop and implement responses appropriate to audit findings.

Principal Investigators also will assess performance through site visits during field sampling and laboratory analysis activities. These individuals will have the authority to modify activities to bring them into conformance with quality control requirements. In the event of continued non-conformance, work associated with the specific activity will be stopped until the appropriate corrective action is implemented.

17. CORRECTIVE ACTION

Corrective action in this project has two components: technical and managerial. Technical correction action involves steps taken to rectify isolated problems associated with performance of specific project activities. Failure to meet minor procedural requirements will be brought to the attention of the Principal Investigator associated with those activities by the technical personnel involved. Using professional judgement on an individual incident basis, a decision will be made as to how to report the infraction and its significance. More serious infractions, such as those involving data acceptability criteria as described above, may result in rejection of an entire data set. In consultation with the SAIC Project Manager, and with consideration of project resources, a decision may be made to repeat the activity following correction of performance deficiencies. All technical correction actions will be documented fully in subsequent reports.

Managerial corrective action involves steps taken to rectify repeated performance issues arising from continued failure to meet project objectives. Such problems may be due to inappropriate activity methodologies, inappropriate staffing assignments, or other causes. The Principal Investigators will jointly assess activity methodologies to identify alternate approaches or modification of project objectives. Decisions will be communicated to the EA Project Manager as appropriate. Staff supervisors and subcontract Project Managers will address problems of performance following the governing employment and contractual agreements.

18. REPORTS

In addition to the specific deliverables listed in Section 8, SOPs will be developed for activities not yet described. These will be included as appendices of this document. All project reports will be prepared in SAIC-specified format.

19. HEALTH AND SAFETY

All project personnel will comply with the Health and Safety policies and protocols. Because no sampling on recognized hazardous waste sites will occur in this project, the OSHA 40-hr training course will not be required of any project personnel. A Health and Safety Plan will be developed following the format included in URI and SAIC (1994).

20. REFERENCES

ERLN and NOSC. 1991. Work/Quality Assurance Project Plan for the NOSC/ERLN Case Study of Estuarine Ecological Risk Assessment at Naval Shipyard Portsmouth: Phase I. (Contact NCCOSC for copies of this document.)

ERLN/NOSC. 1991. Work/Quality Assurance Plan for Marine Ecological Risk Assessment Pilot Study. U.S. EPA Environmental Research Laboratory, Narragansett, RI.

Johnston, R.K., P.E. Woods, G.G. Pesch and W.R. Munns, Jr. 1990. Assessing the impact of hazardous waste disposal sites on the environment: Case studies of ecological risk assessments at selected Navy hazardous waste disposal sites. *Proceedings of the Environmental Research and Development (R&D) Technical Workshop* (R.K. Johnston and E.F. Wilkins, eds.), Naval Ocean Systems Center Technical Document 1792, San Diego, CA, pp. 143-167.

Johnston, R.K. and S.W. Nixon. 1994. Cleaning up hazardous waste sites in the coastal zone: A review of the federal and state legal requirements for remediation at Allen Harbor, Narragansett Bay, Rhode Island, in *"Organizing for the Coast"*, Conference Proceedings of the Coastal Society Thirteenth International Conference (M.P. Lynch and B. Crowder, eds.), Coastal Society, Gloucester, MA, pp. 509-523.

Miniuks, A.F. 1994. Memo to Deborah Carlson, RPM, Re: EPA review of the draft Work/Quality Assurance Plan for Narragansett Bay ecorisk and monitoring for Navy sites, Naval Education and Training Center (NETC), Newport, Rhode Island.

Mueller, C., W.R. Munns, Jr., D. Cobb, E.A. Petrocelli, G.G. Pesch, W.G. Nelson, D.M. Burdick, F.T. Short, and R.K Johnston (eds). 1992. Standard operating procedures and field methods used for conducting ecological risk assessment case studies: Naval Construction Battalion Center Davisville, RI and Naval South Aquidneck Island subarea Portsmouth, Kittery, ME. NCCOSC Tech. Doc. 2296, San Diego, CA, 470pp.

Munns, W.R., Jr., C.A. Mueller, D.J. Cobb, T.R. Gleason, G.G. Pesch and R.K. Johnston. 1991. Marine Ecological Risk Assessment at NCBC Davisville, RI. Phase I. NOSC Technical Report 1437, San Diego, CA, 237pp.

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Munns, W.R., Jr., C.A. Mueller, B. Rogers, S. Benyi, S. Anderson, W.G. Nelson, and R.K. Johnston. 1994a. Marine Ecological Risk Assessment at Naval Construction Battalion Center, Davisville, Rhode Island -- Phase III. Report prepared for the Naval Command, Control and Ocean Surveillance Center, ERLN Contribution No. 1428.

Norton, S.B., D.J. Rodier, J.H. Gentile, W.H. van der Schalie, W.P. Woods, and M.W. Slimak. 1992. A framework for ecological risk at the EPA. Env. Tox. & Chem. 11: 1663-1672.

NCCOSC/ERLN. 1992. Scope of Work Phase II: Estuarine Ecological Risk Assessment for Naval Shipyard Portsmouth (NSYP), Kittery, Maine, May 27, 1992. Addendum to Work/Quality Assurance Project Plan for the NOSC/ERLN Case Study of Estuarine Ecological Risk Assessment at Naval Shipyard Portsmouth: Phase I. (Contact NCCOSC for copies of this document.)

NCCOSC, ERLN, and UNH. 1993. Work/Quality Assurance Project Plan for the NOSC/ERLN Case Study of Estuarine Ecological Risk Assessment at Naval South Aquidneck Island subarea Portsmouth: Phase II. (Contact NCCOSC for copies of this document.)

NOSC and ERLN. 1990. Risk Assessment Pilot Study for Allen Harbor, Naval Construction Battalion Center Davisville, RI: Project Documentation. (Contact NCCOSC for copies of this document.)

Stanley, T.W. and S.S. Verner. 1983. Interim guidelines and specifications for preparing quality assurance project plans. EPA/600/4-83/004, U.S. Environmental Protection Agency, Washington, D.C.

URI and SAIC. 1994. Draft Work/Quality Assurance Project Plan for the Narragansett Bay Ecorisk and Monitoring for Navy Sites: Offshore Ecological Risk Assessment for the Lower East Passage Study Area. 12 July 1994. Submitted to Haliburtun NUS, Mr. Steve Parker, Project Officer.

Winger, P.V. and P.J. Lasier, 1991. A Vacuum-operated pore-water extractor for estuarine and freshwater sediments. Arch. Environ. Contam. Toxicol. 21:321-324.

U.S. Environmental Protection Agency (USEPA). 1992. Framework for ecological risk assessment. Risk Assessment Forum, EPA/630/R-92/001, Washington, DC, 41 pp.

EA Engineering, Science, and Technology

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Fax: 617-784-4539

27 July 1994

Mr. Bob Krivinskas
Remedial Project Manager
Northern Division
Naval Facilities Engineering Command
10 Industrial Highway, Mail Stop 82
Lester, Pennsylvania 19113-2090

RE: Comments and Alternative to the Lower Aquifer and Bedrock Contamination Investigation Request, Allen Harbor Landfill, NCBC-Davisville, Rhode Island
Contract No. N62472-92-1296, CTO No. 32
EA Project No. 29600.32.0099

Dear Mr. Krivinskas:

As a result of reviewing TRC's Draft Allen Harbor Landfill Remedial Investigation Report (TRC Report) for EA's preparation of the project work plan and cost proposal for the referenced CTO, it appears to be premature to proceed with additional investigation of the lower aquifer and bedrock (Tasks 10, 11, and 12) at this time. The following will present EA's findings and recommended alternative investigation.

The main purpose of the requested investigative work is to evaluate the extent of the dissolved chlorinated solvents detected in the one ground-water sample collected from Well MW-7D during the July-August 1993 sampling event. Well MW-7D is screened in the lower aquifer (silt) just above the bedrock surface (Figures A through E). A summary of the data for the "deep ground-water" samples is shown on Figure F, which also shows that the MW-7D sample detected volatile organic compound parameters are the highest of all the deep ground-water samples collected. Additionally, the detected MW-7D volatile organic compounds concentration is considerably higher than the highest detected in the shallow ground-water sample (Figure G).

One interpretation of the above data is that dissolved chlorinated solvents are locally present in the lower aquifer and perhaps the upper portion of the bedrock. However, a review of the MW-7D monitoring well log (Figure A) and geological cross-sections (Figures C through E) support another interpretation. Based upon the TRC boring and well logs, Figure H presents an interpretive contour map of upper surface of the gray silt unit. The contours indicate a depression in the vicinity of MW-7D which may be part of a former north-south trending stream channel that may have been cut into the gray silt unit. Because chlorinated solvents are heavier than water, they tend to sink through an aquifer by gravity until encountering the surface of a sediment/rock unit of a significantly lower vertical permeability, e.g., silt and clay. Such a solvent can then flow by gravity down that surface and collect in depressions in that surface. Based upon Figure H and geological cross-section Figures C through E, Well MW-7D appears to be installed on a bedrock high and through a depression in the surface of the overlying gray silt unit within which solvent could collect. Additionally, this apparent depression has been naturally backfilled with fine to coarse sandy material which, in turn, is overlain by landfilled material. The extent of this depression filled by sandy material is only very roughly defined at this time.

The monitoring well log for MW-7D (Figure A) states that a "TCE odor" was first encountered in the sediment sample collected from 29 to 31 ft below grade (within the fine to coarse sand lens about 5 ft above the surface of the gray silt). The "TCE odor" may be from solvent collected within the sandy lens as a contaminant source area above the silt layer. Because this zone is below the ground-water table, the solvent and odor may have been carried downward into the silt layer during the well drilling activity. Additionally, based upon Figure A, the top of the monitoring well filter sand is 39 ft below grade, while the upper surface of the gray silt unit is only 5 ft above, at 34 ft below grade. Any breach in integrity of the well seal could cross-connect the potential solvent source area and the well screen. The other Phase II deep wells have been constructed such that there is approximately 18-42 ft of the gray silt unit above the top of the wells' filter sand pack.

A clearer understanding of the depression in the upper surface of the gray silt unit and the extent of the potential solvent source area in the overlying sand is necessary to provide data for: (1) selection of bedrock monitoring well locations, (2) minimize the potential for cross-contamination to the bedrock when investigation of the bedrock occurs, and (3) support design of the site remediation plan. Figure I shows the recommended locations for additional monitoring wells. It is proposed that these wells would be installed approximately 1 ft into the gray silt unit to evaluate the extent of the depression and solvent source area beginning in the vicinity of MW-7D. Split-spoon sampling of the sediment would be performed at 5-ft intervals to a depth of 15-20 ft and then continuously to about 5 ft into the gray silt unit.

We trust that this explanation satisfactorly presents EA's concern about, and alternative to proceeding directly with a Lower Aquifer and bedrock investigation at this time. If you have any questions, please do not hesitate to contact either of the under signed at (617) 784-1767.

Sincerely,

Nicholas Lanney

Nicholas A. Lanney, P.E.
CTO Manager

Jim Shultz

James A. Shultz
Senior Geologist

kh/JS
Attachments

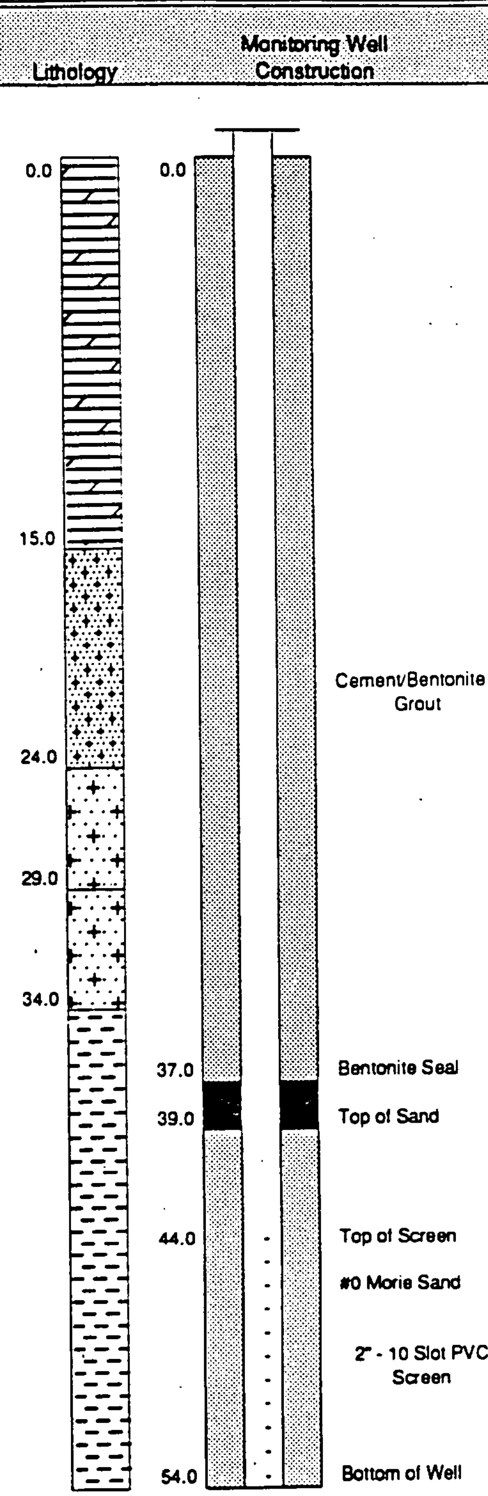
Monitoring Well: MW-7D
Site 09 - Allen Harbor Landfill
NCBC - Davisville
Well Depth: 54 FEET

Drilling Company: D.L Maher
Drillers: J. Graglia & B. Burns
TRC Inspector: T. McMorrow
Monitoring Well Coordinates:
N 196,790.27
E 522,584.88

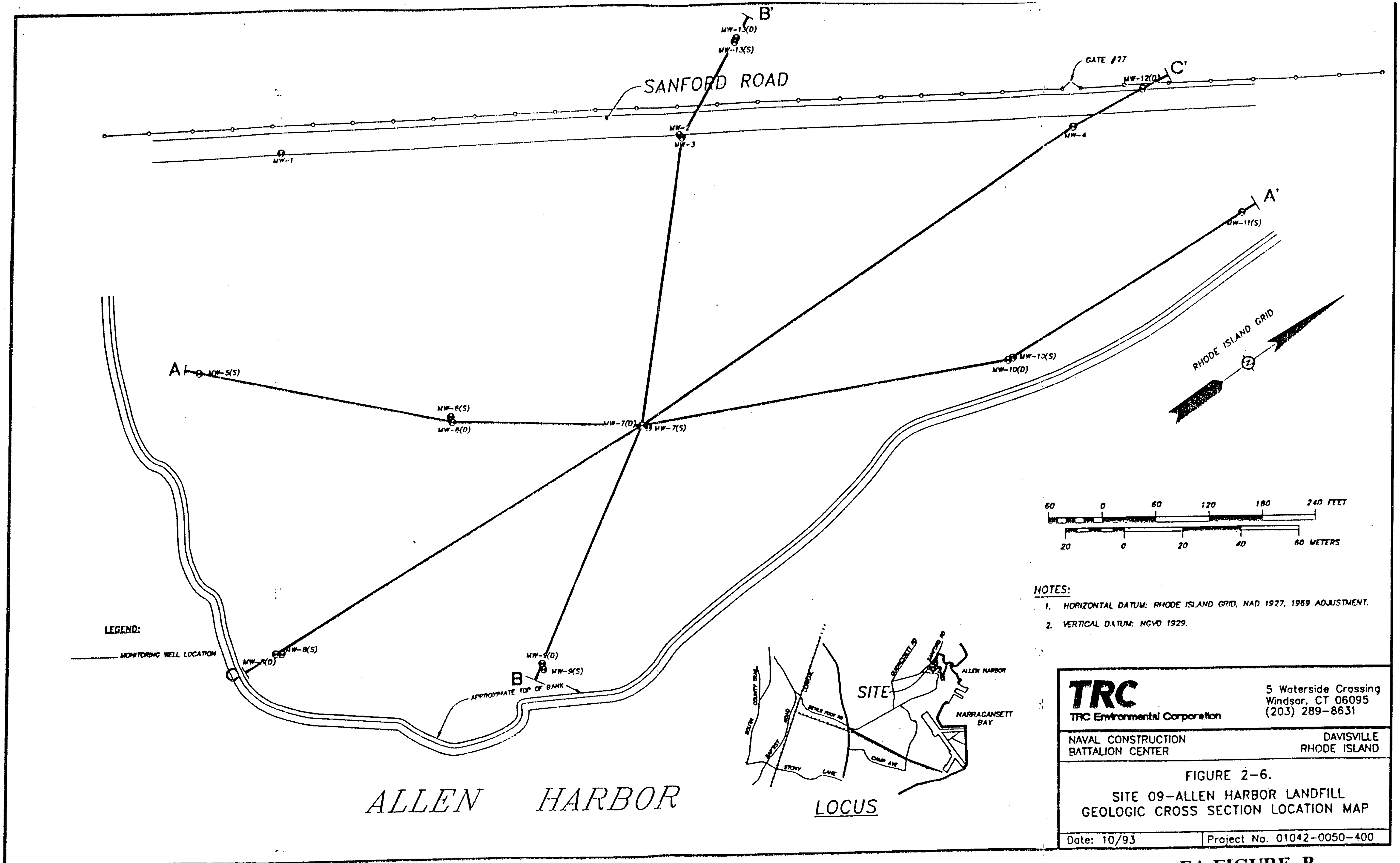
Date Started: JUNE 4, 1993
Date Completed: JUNE 4, 1993
Depth to Water: 15 Feet
Monitoring Well Elevations:
Top of PVC = 21.39
Ground Elevation = 19.35

Depth (feet)	Blow Counts		Field Measurements OVA (ppm)	HNu (ppm)	Soil Description
0-2	4	100/3"	4	0	0-6" Black M-C SAND, tr. gravel. 6-12" Brown F-M SAND, little gravel, no odor.
2-4	6 6	6 6	>1000	0	0-4" Black F-M SAND, little gravel. 4-18" Lt Brown M-C SAND, some gravel, dry, no odor.
4-6	7 9	8 13	30	0	0-6" Lt. Brown M-C SAND, little gravel. 6-12" Lt gray M-C SAND, little gravel, dry, on odor.
6-8	31 70	76 80	50	8	0-6" Brown F-M SAND, little gravel. 6-12" FILL, paper, plastic, wood, metal. 12-18 Same as 0-6" interval, garbage odor, dry.
9-11	49 46	40 35	800	4	0-6" FILL, garbage, paper, glass. 6-24" Black FILL, sand, wood, glass, dry, garbage odor.
11-13	18 35	45 57	120	0	Same as 6-24" interval above, rock in tip, slight odor, dry. 14" recovery.
13-15	42 48	50 32			No recovery, cloth stuck in basket of split spoon, wet.
15-17	16 9	10 9	1000	1	Black F-M SAND, tr gravel, no odor, wet. 16" recovery.
20-22	5 8	5 10	300	0	Brown M-C SAND, wet. 12" recovery.
24-26	10 12	10 18	25	0	0-8" Gray SILT, little f sand. 8-12" Gray F-M Sand, wet. 12" recovery.
29-31	7 8	8 8	70	-	Gray M-C SAND, some silt & silt layers, wet, TCE odor. 15" recovery.
34-36	8 4	2 3	20	-	Gray SILT, tr F sand, wet, TCE odor. 6" recovery.
39-41	2 2	1 2	90	-	Gray SILT, tr f sand, wet, TCE odor. 14" recovery.
44-46	3 2	2 3	40	-	Gray stiff SILT, tr f sand, little TCE odor. 20" recovery.
49-51	6 2	2 4	10	-	Same as above, weak TCE odor. 10" recovery.
54-56	100/3"		-	-	No recovery, augered into bedrock at 54.5'.

Sample 09-MW7-23 collected from 44-46'

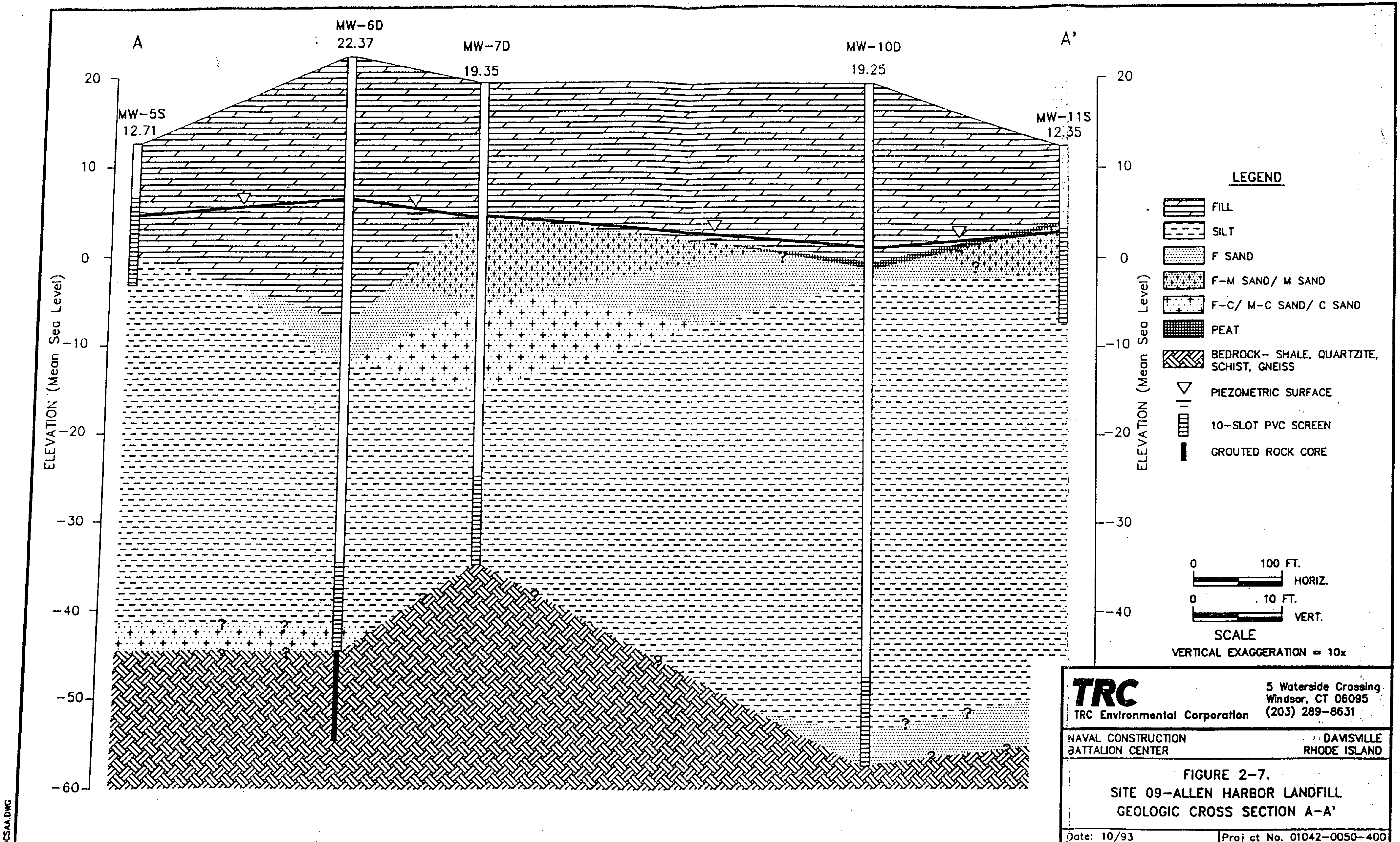


EA FIGURE A



SANFORD ROAD
GATE #27
B'
C'
A'
A
B
MW-1
MW-2
MW-3
MW-4
MW-5(S)
MW-6(S)
MW-6(D)
MW-7(D)
MW-7(S)
MW-8(S)
MW-8(D)
MW-9(D)
MW-9(S)
MW-10(S)
MW-10(D)
MW-11(S)
MW-12(D)
MW-13(D)
MW-13(S)
APPROXIMATE TOP OF BANK
RHODE ISLAND GRID
60 0 60 120 180 240 FEET
20 0 20 40 60 METERS
NOTES:
1. HORIZONTAL DATUM: RHODE ISLAND GRID, NAD 1927, 1969 ADJUSTMENT.
2. VERTICAL DATUM: NGVD 1929.
LEGEND:
MONITORING WELL LOCATION
ALLEN HARBOR
SITE
ALLEN HARBOR
NARRAGANSETT BAY
CAMP AVE
STONY LANE
LOCUS
TRC
TRC Environmental Corporation
5 Waterside Crossing
Windsor, CT 06095
(203) 289-8631
NAVAL CONSTRUCTION BATTALION CENTER
DAVISVILLE RHODE ISLAND
FIGURE 2-6.
SITE 09-ALLEN HARBOR LANDFILL
GEOLOGIC CROSS SECTION LOCATION MAP
Date: 10/93
Project No. 01042-0050-400

EA FIGURE B


A
A'
MW-6D
22.37
MW-7D
19.35
MW-10D
19.25
MW-5S
12.71
MW-11S
12.35
ELEVATION (Mean Sea Level)
20
10
0
-10
-20
-30
-40
-50
-60
LEGEND
FILL
SILT
F SAND
F-M SAND/ M SAND
F-C/ M-C SAND/ C SAND
PEAT
BEDROCK- SHALE, QUARTZITE, SCHIST, GNEISS
PIEZOMETRIC SURFACE
10-SLOT PVC SCREEN
GROUTED ROCK CORE
0
100 FT.
HORIZ.
10 FT.
VERT.
SCALE
VERTICAL EXAGGERATION = 10x
TRC
TRC Environmental Corporation
5 Waterside Crossing
Windsor, CT 06095
(203) 289-8631
NAVAL CONSTRUCTION
BATTALION CENTER
DAVISVILLE
RHODE ISLAND
FIGURE 2-7.
SITE 09-ALLEN HARBOR LANDFILL
GEOLOGIC CROSS SECTION A-A'
Date: 10/93
Proj ct No. 01042-0050-400
9CSAA.DWG

EA FIGURE C

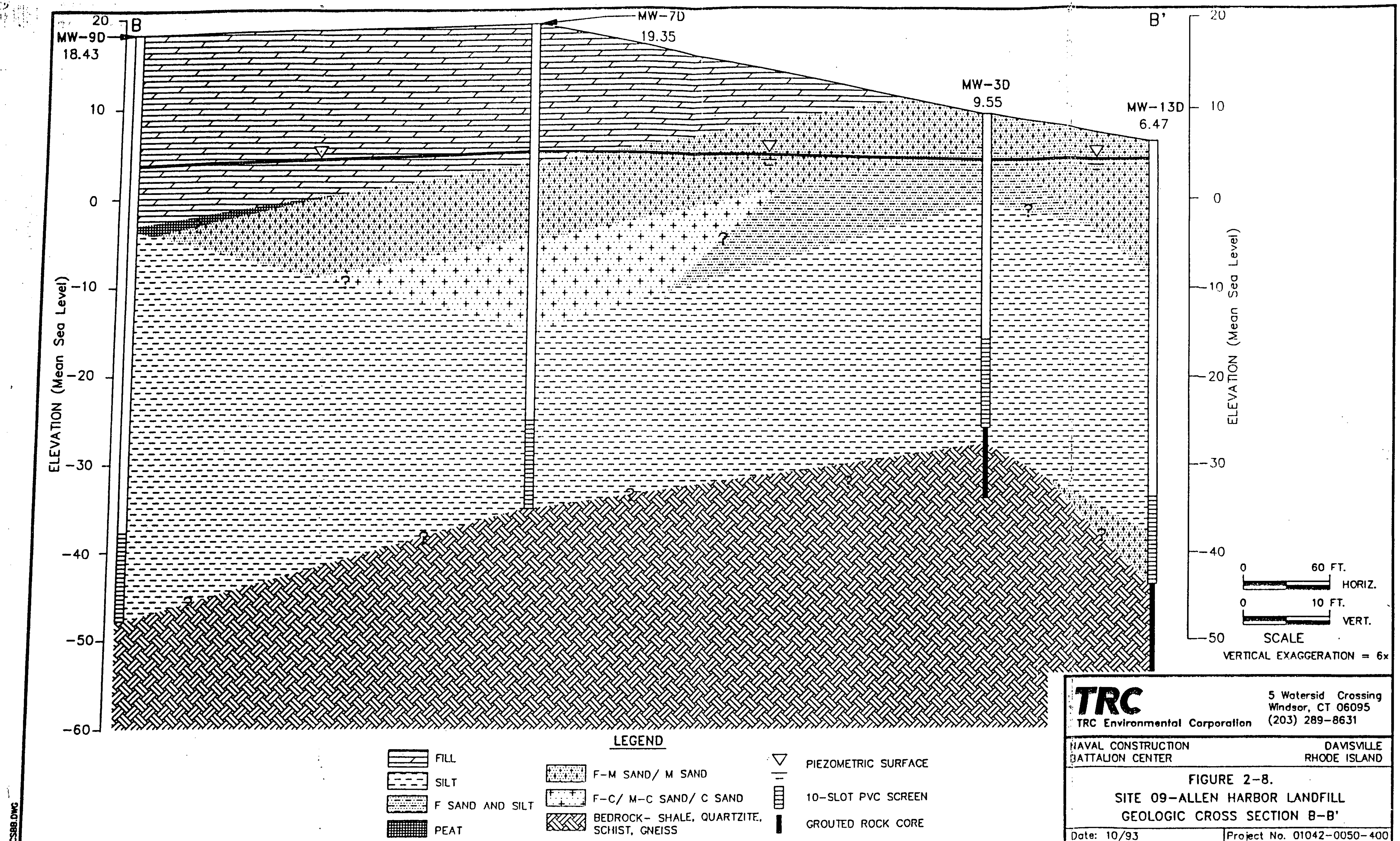


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FIGURE 2-8.
SITE 09-ALLEN HARBOR LANDFILL
GEOLOGIC CROSS SECTION B-B'

Date: 10/93 | Project No. 01042-0050-400

EA FIGURE D

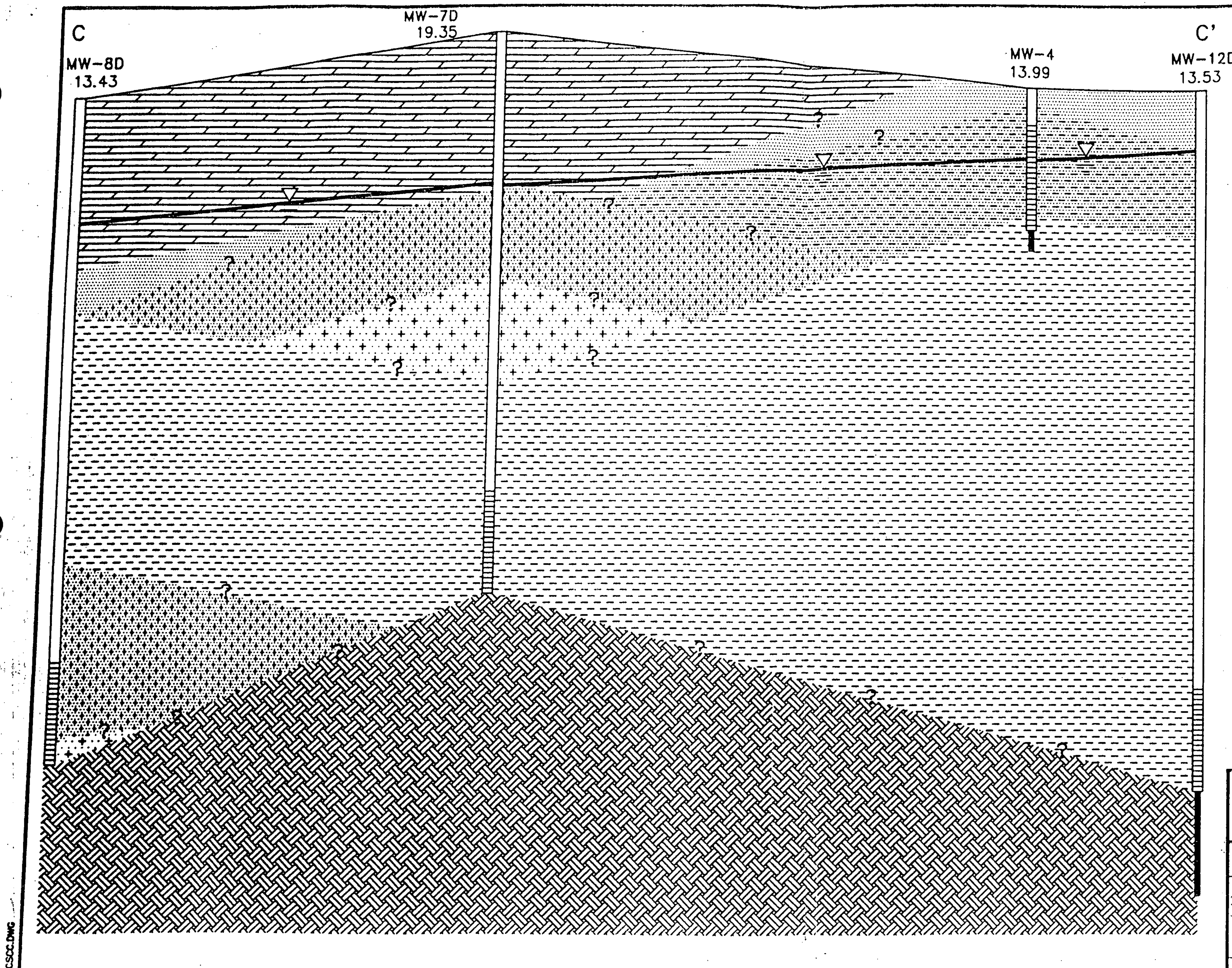

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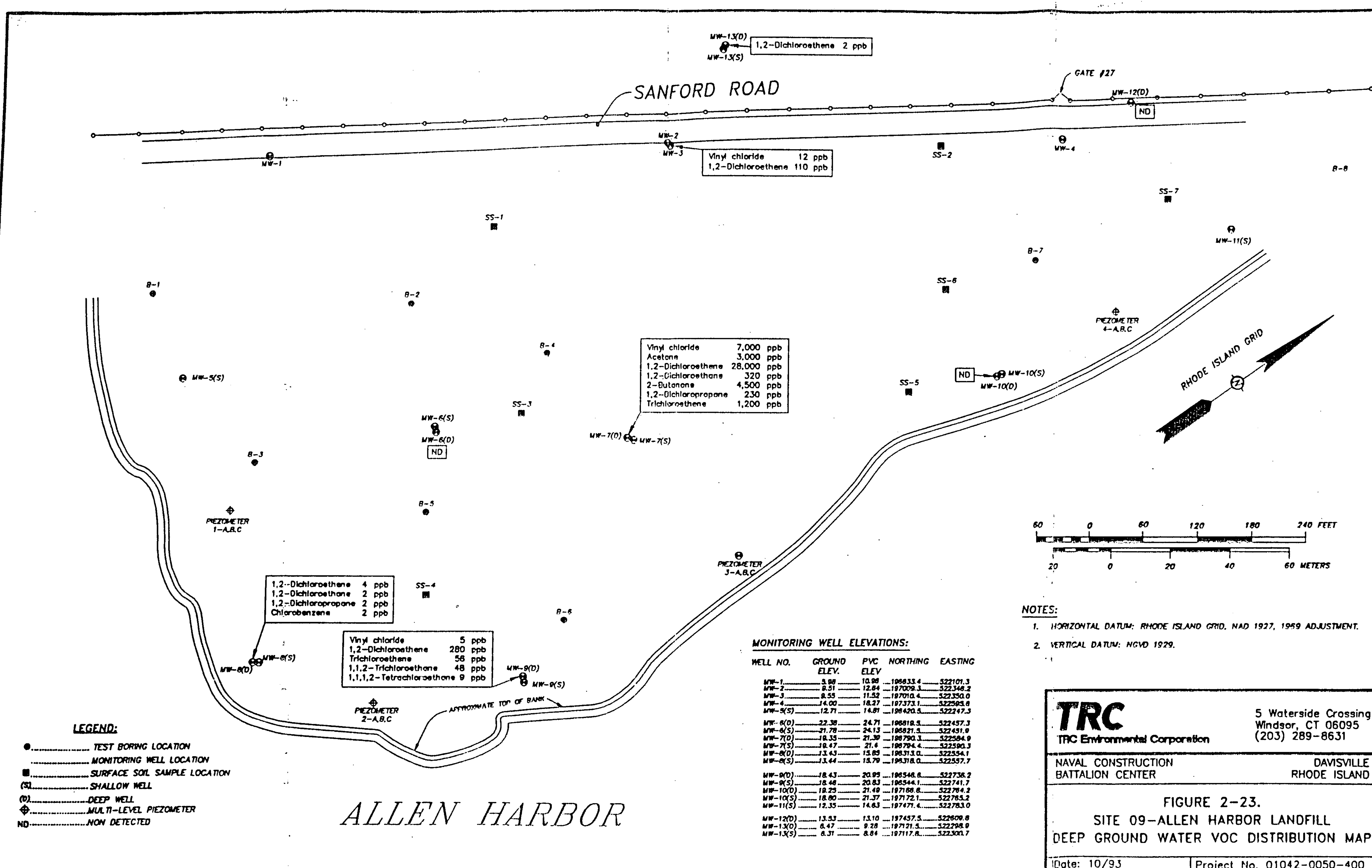
FIGURE 2-9.
SITE 09-ALLEN HARBOR LANDFILL
GEOLOGIC CROSS SECTION C-C'

Date: 10/93 | Project No. 01042-0050-400

EA FIGURE E



MONITORING WELL ELEVATIONS:

WELL NO.	GROUND ELEV.	PVC ELEV	NORTHING	EASTING
MW-1	9.98	10.98	196833.4	522101.3
MW-2	8.51	12.64	197009.3	522348.2
MW-3	8.55	11.52	197010.4	522350.0
MW-4	14.00	18.27	197373.1	522595.8
MW-5(S)	12.71	14.81	196420.5	522247.3
MW-6(D)	22.38	24.71	196819.5	522457.3
MW-6(S)	21.78	24.13	196821.5	522451.9
MW-7(D)	19.35	21.39	196790.3	522584.9
MW-7(S)	19.47	21.6	196794.4	522590.3
MW-8(D)	13.43	15.89	196313.0	522554.1
MW-8(S)	13.44	15.79	196318.0	522557.7
MW-9(D)	18.43	20.95	196546.6	522736.2
MW-9(S)	18.48	20.83	196544.1	522741.7
MW-10(D)	19.25	21.49	197168.6	522764.2
MW-10(S)	18.80	21.37	197172.1	522765.2
MW-11(S)	12.35	14.63	197471.4	522783.0
MW-12(D)	13.53	13.10	197457.5	522609.8
MW-13(D)	6.47	9.28	197121.5	522298.9
MW-13(S)	6.31	8.84	197117.8	522300.7

NOTES:

1. HORIZONTAL DATUM: RHODE ISLAND GRID, NAD 1927, 1959 ADJUSTMENT.
2. VERTICAL DATUM: NGVD 1929.

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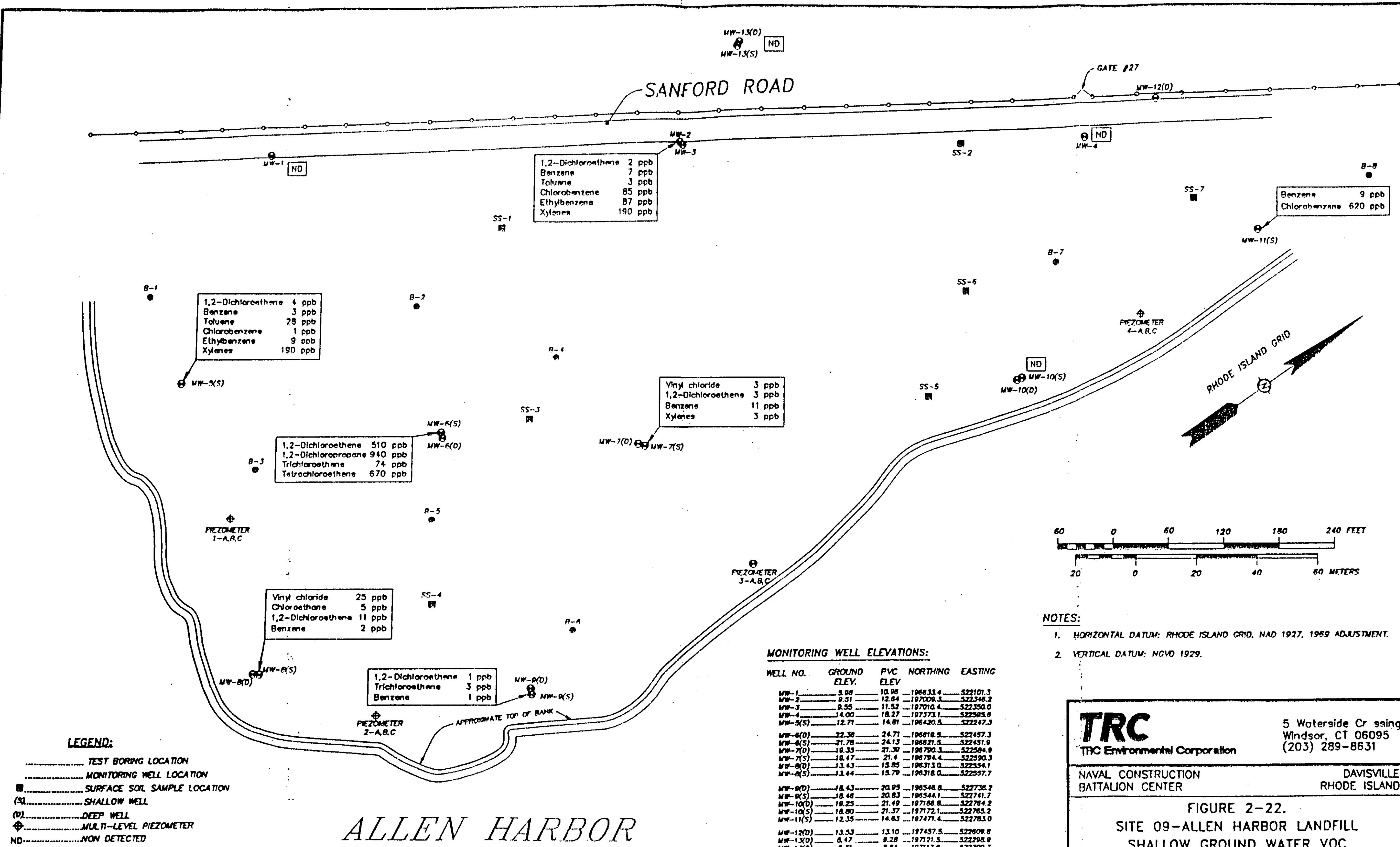
NAVAL CONSTRUCTION BATTALION CENTER — DAVISVILLE RHODE ISLAND

FIGURE 2-23.
SITE 09-ALLEN HARBOR LANDFILL
DEEP GROUND WATER VOC DISTRIBUTION MAP

Date: 10/93 | Project No. 01042-0050-400

EA FIGURE F



MONITORING WELL ELEVATIONS:

WELL NO.	GROUND ELEV.	PVC ELEV	NORTHING	EASTING
MW-1	5.98	10.96	196833.4	522101.3
MW-2	9.51	12.64	197009.3	522348.2
MW-3	9.55	11.52	197010.4	522350.0
MW-4	14.00	18.27	197373.1	522585.6
MW-5(S)	12.71	14.81	196420.5	522247.3
MW-6(D)	22.38	24.71	196818.5	522457.3
MW-6(S)	21.78	24.13	196821.5	522451.9
MW-7(D)	19.35	21.39	196790.3	522584.9
MW-7(S)	19.47	21.4	196794.4	522590.3
MW-8(D)	13.43	15.85	196313.0	522554.1
MW-8(S)	13.44	15.79	196318.0	522557.7
MW-9(D)	18.43	20.95	196548.8	522738.2
MW-9(S)	18.48	20.83	196544.1	522741.7
MW-10(D)	19.25	21.49	197168.8	522784.2
MW-10(S)	18.80	21.37	197172.1	522785.2
MW-11(S)	12.35	14.63	197471.4	522783.0
MW-12(D)	13.53	13.10	197457.5	522609.8
MW-13(D)	6.47	9.28	197121.5	522298.9
MW-13(S)	6.31	8.84	197117.6	522300.7

NOTES:

1. HORIZONTAL DATUM: RHODE ISLAND GRID, NAD 1927, 1969 ADJUSTMENT.
2. VERTICAL DATUM: NGVD 1929.

TRC
TRC Environmental Corporation
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Windsor, CT 06095
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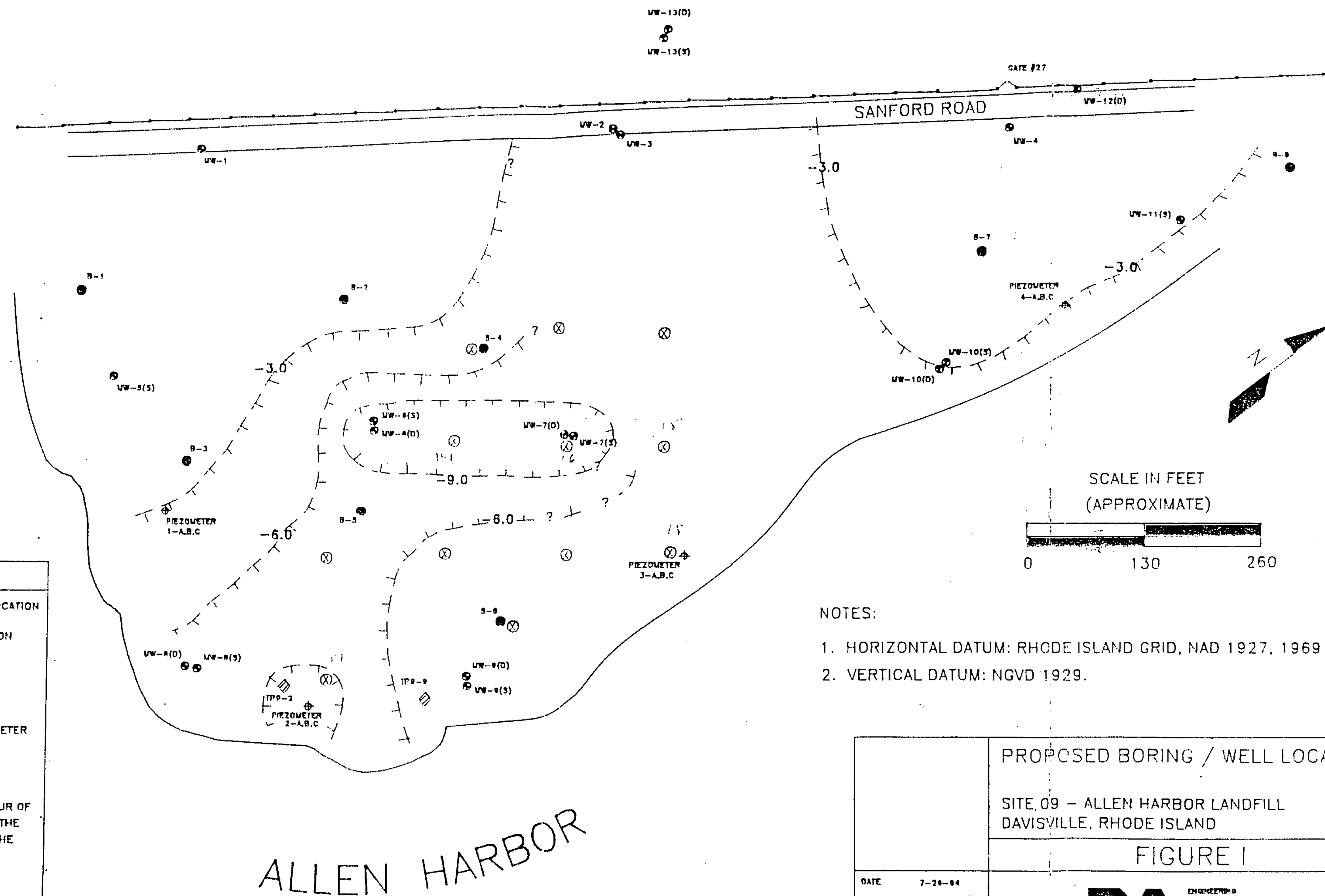
NAVAL CONSTRUCTION BATTALION CENTER — DAVISVILLE RHODE ISLAND

FIGURE 2-22.
SITE 09-ALLEN HARBOR LANDFILL
SHALLOW GROUND WATER VOC
DISTRIBUTION MAP

Date: 10/93 | Project No. 01042-0050-400

EA FIGURE G



LEGEND

- MONITORING WELL LOCATION
- TEST BORING LOCATION
- (S) SHALLOW WELL
- (D) DEEP WELL
- MULTI-LEVEL PIEZOMETER
- TEST PIT LOCATION
- INTERPRETIVE CONTOUR OF EQUAL ELEVATION OF THE UPPER SURFACE OF THE GRAY SILT UNIT
- PROPOSED BORING/ WELL LOCATIONS

SOURCE: BASE MAP MODIFIED FROM FIGURES 2-2 AND 2-3 OF THE TRC DRAFT ALLEN HARBOR LANDFILL REMEDIAL INVESTIGATION REPORT, VOLUME 1, NOVEMBER 1993.

NOTES:

1. HORIZONTAL DATUM: RHODE ISLAND GRID, NAD 1927, 1969 ADJUSTMENT.
2. VERTICAL DATUM: NGVD 1929.

PROPOSED BORING / WELL LOCATIONS

SITE 09 – ALLEN HARBOR LANDFILL
DAVISVILLE, RHODE ISLAND

FIGURE 1

DATE	7-26-94	PROJECT NUMBER	29600.32/0089
DESIGNED BY	CML	SCALE	AS SHOWN
DRAWN BY	CML	FILE NAME	A:ALLEN2
CHECKED BY	JAS	DRAWING NUMBER	
PROJECT MANAGER	JAS	SHEET NUMBER	

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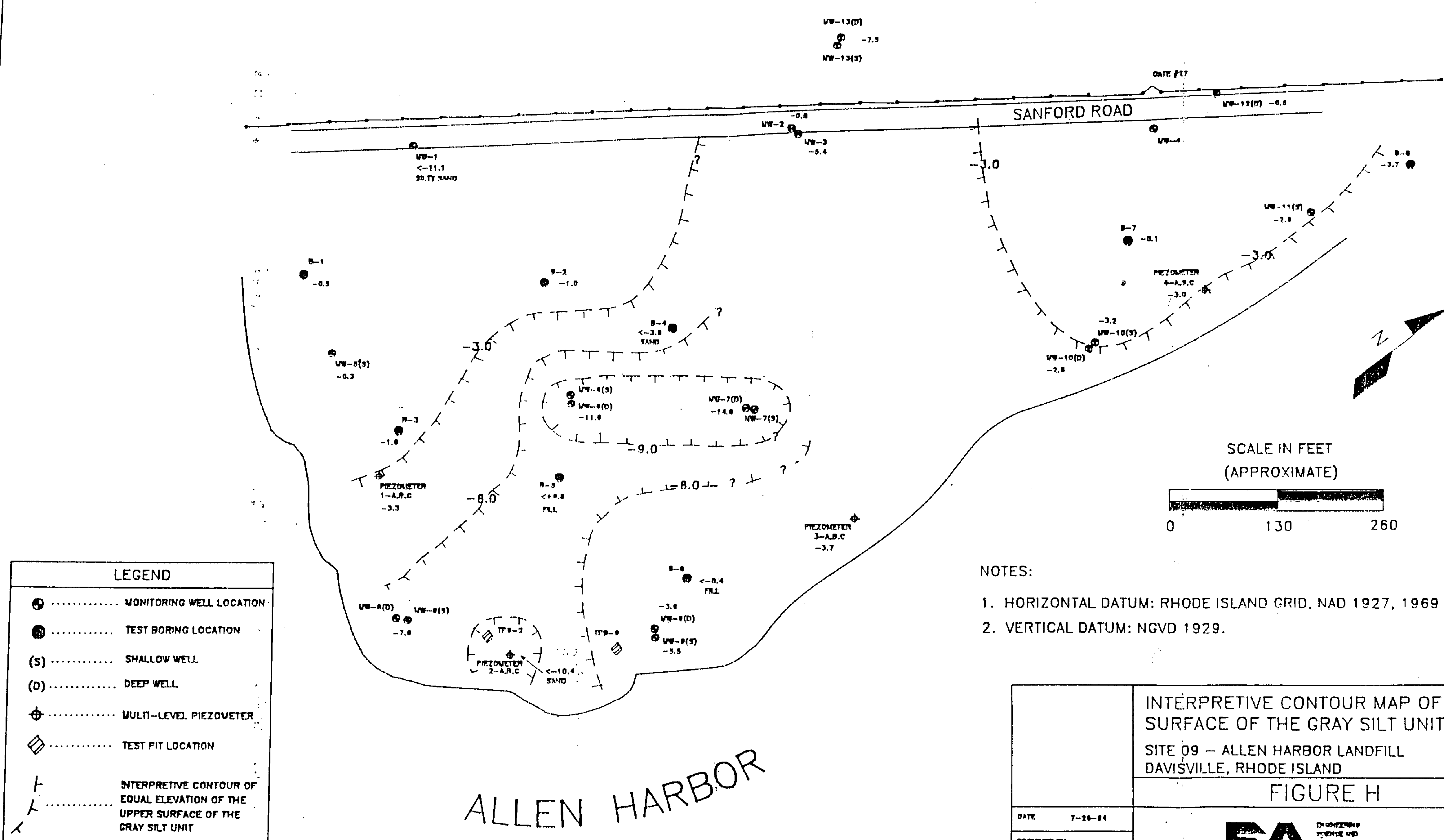

NOTES:

1. HORIZONTAL DATUM: RHODE ISLAND GRID, NAD 1927, 1969 ADJUSTMENT.
2. VERTICAL DATUM: NGVD 1929.

SOURCE: BASE MAP MODIFIED FROM FIGURES 2-2 AND 2-3 OF THE TRC DRAFT ALLEN HARBOR LANDFILL REMEDIAL INVESTIGATION REPORT, VOLUME 1, NOVEMBER 1993.

INTERPRETIVE CONTOUR MAP OF THE UPPER SURFACE OF THE GRAY SILT UNIT

SITE 09 – ALLEN HARBOR LANDFILL
DAVISVILLE, RHODE ISLAND

FIGURE H

DATE	7-29-94
DESIGNED BY	GML
DRAWN BY	GML
CHECKED BY	JAS
PROJECT MANAGER	JAS

SHARON COMMERCE CENTER
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SHARON, MASSACHUSETTS 02067
(617) 784-1767

PROJECT NUMBER	19660.32/0099
SCALE	AS SHOWN
FILE NAME	ALLEN
DRAWING NUMBER	
SHEET NUMBER	

APPENDIX E

FACILITY-WIDE ECOLOGICAL RISK ASSESSMENT

NAVAL CONSTRUCTION BATTALION CENTER
DAVISVILLE, RHODE ISLAND

Contract No. N62472-92-D-1296
Contract Task Order No. 0032

Prepared for

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Northern Division
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October 1994
DRAFT
EA PROJECT 296.0032

APPENDIX E

FACILITY-WIDE ECOLOGICAL RISK ASSESSMENT ACTIVITIES

The draft ecological risk assessment for the Naval Construction Battalion Center (NCBC), Davisville, Rhode Island was reviewed by U.S. EPA Region I and other regulatory agencies. These comments were considered by the Navy and its contractor, TRC Environmental, and responses were issued by TRC Environmental in March 1994. The draft final ecological risk assessment was issued in June 1994. In August, 1994, EPA Region I released further comments, which documented the degree to which the June 1994 draft final document addressed the comments originally submitted by EPA. On September 1, 1994, a meeting among the interested parties resulted in discussions concerning the additional work needed to address EPA Region I's concerns with the June 1994 document. In this document, the activities necessary to address these concerns are detailed.

1. ADDITIONAL RISK ASSESSMENT ACTIVITIES

In response to EPA Comment No. 72, the ecological risk assessment will be expanded to address the following issues:

a. As appropriate, either qualitative or quantitative risk analyses will be documented for the selected contaminants of concern (COCs), for as many species/exposure zone scenarios as possible. For example, there may be species of concern for which no toxic reference value exists, in which case it will not be possible to discuss the risk for that receptor, either qualitatively or quantitatively.

b. COC-specific Hazard Quotients (HQs) will be presented for the COCs listed in Tables 12 through 14, and indicator species (e.g., mink, robin, tern, and shrew) for which food chain exposures were assessed in the Ecological Risk Assessment (ERA).

c. Aggregate Hazard Indices (HIs; sum of HQs) for the exposures of benthic communities, pelagic communities (water column), and indicator species to mixtures of COCs in all exposure zones will be calculated and presented, as appropriate.

d. HQs and/or HIs for both the average and maximum (or upper bound) COC concentrations for sediment and surface water exposures will be calculated and presented, including HIs for upland soil and shrews.

e. Supplemental toxicity endpoints for birds and mammals will be presented where they are available.

2. WETLAND SAMPLING AND EXPOSURE ASSESSMENTS

In response to EPA Comment No. 73, the following activities will be undertaken:

a. Freshwater wetlands on the sites will be shown in one or more figures.

b. Additional sampling will be performed in the vegetated, non-channelized areas of the freshwater wetlands on the sites, specifically in the Hunt River and Sandhill Brook watersheds. The nature and extent of this additional sampling is to be determined following a detailed review of EPA's comments concerning the existing ERA for NCBC Davisville; a supplemental work plan will be submitted with additional details.

c. Exposure to shrews and robins to depositional sediments in freshwater wetlands will be assessed.

d. The risks to mink and hawk from consumption of prey in depositional sediments in the freshwater wetlands will be assessed, including those areas in the vicinity of the landfill, and the Hunt River and Sandhill Brook watershed wetlands.

3. DATA PRESENTATION

In response to EPA Comment No. 74, the data presentation of the ERA will be modified to allow the reader to verify that an adequate selection of inorganic and organic COCs has been made, and has been carried through the ERA in an appropriate manner for each site.

4. EXPOSURE AND RISK ASSESSMENT SUMMARY TABLES

In response to EPA Comment No. 75, the following risk calculations and summary tables will be provided:

a. The pairings of ecological receptors with their exposure zones, within which either direct or food-chain-mediated exposures were assessed, will be supplied in a tabular form, such as a two-way matrix.

b. The average and maximum (or upper bound) HQs calculated for all COCs, and resultant HIs, for each receptor/exposure zone pairing, will be presented in a similar tabular or matrix form.

c. COC-specific HQs, and appropriate aggregate HIs, will be tabulated for the mink and least tern.

d. Existing data for upstream, reference sample locations will be included in the surface water and sediment data and risk quotient summary tables.

5. AVERAGE AND MAXIMUM HQs/HIs

In response to EPA Comment No. 76, further consideration will be accorded to the EPA Region I's requirement that COC-specific and aggregate risks be calculated, using HQs and HIs, for both the average and maximum COC concentrations detected, although this requirement is not specified in EPA guidance documents. The appropriateness of utilizing a maximum value in estimating exposure for species which range over a reasonable area will be reevaluated, specifically regarding indicator species such as the shrew.

The elimination of COCs from risk characterizations for receptor/exposure zone pairs will be documented as appropriate.

6. TERRESTRIAL CONTAMINATION AND RISKS

In response to EPA Comment No. 78, the following actions will be taken:

a. The extent of terrestrial contamination will be summarized in the ERA, based on existing information in the RI report.

b. The COC selection process will be explained in further detail in the appropriate sections of the ERA.

c. Terrestrial exposure risk assessment calculations for all site-specific COCs, for the mink, shrews, robins, and hawks will be presented, where endpoints are available for the COC/species pairs, and where elimination for other reasons, such as range restrictions or other factors, is not appropriate.

7. HUNT RIVER

In response to EPA Comment No. 79, additional field sampling will be undertaken in the Hunt River watershed. This field sampling will include both biological and analytical chemistry sampling. The nature and extent of this sampling has not yet been determined, because ideally the exact placement of the samples should be established during a site visit by an experienced ecologist and risk assessor. The biological sampling should be scheduled for early spring, because at the current time it is too late in the season to collect biological samples which would be representative of the watershed during the growing season.

8. AMBIENT WATER QUALITY CRITERIA

In response to EPA Comment No. 80, the ambient water quality criteria for lead, arsenic, and chromium will be checked to ensure that the numerical criteria are accurate, and that the metallic species referenced is appropriate.

9. POPULATION/ECOSYSTEM-LEVEL RISKS

In response to EPA Comment No. 81, the risk discussion for mink will be reviewed to ensure that it addresses the population-level risk to mink associated with the low population densities in the highly disturbed and developed area around Davisville. Potential population- and ecosystem-level risks and consequences of the organismal and community level risks calculated for benthic biota, as well as for the individual indicator species assessed, will be discussed.

10. SANDHILL BROOK

In response to EPA Comment No. 83, the risk assessment discussion will clarify the position of Station 27 with respect to potential contaminant sources to Sandhill Brook, including the photographic processing facility. If appropriate, risks from other sources than sediments will be discussed in the ERA, including the apparent exceedence of the chronic AWQC for aluminum downstream of the photographic processing facility at Station 28.

11. FRESHWATER BENTHIC COMMUNITY CHARACTERIZATIONS

In response to EPA Comment No. 84, additional samples will be collected in the freshwater watersheds. As discussed above regarding Wetland Sampling and Exposure Assessments (EPA Comment No. 73), and Hunt River (EPA Comment No. 79), EPA has requested additional sampling in the freshwater wetlands, in order to better characterize the potential impact on these communities from sources associated with NCBC Davisville. The additional samples will be collected from the following watersheds:

- Hunt River/Frenchtown Creek Watershed (incorporates Site 10),
- Sandhill Brook Watershed (incorporates Site 08),
- Mill Brook Watershed (incorporates Site 11),
- Hall Creek Watershed (incorporates Sites 02, 03, 05, 06, and 13), and
- Allen Harbor Watershed (incorporates Sites 07 and 09).

Further details concerning these additional samples will be provided following a review of EPA's comments and the existing ERA, in the form of a supplemental work plan.

12. WETLAND FUNCTIONAL EVALUATION

In response to EPA Comment No. 85, the ERA will be revised to more completely characterize the uncertainty associated with the wetland functional evaluation. In the event that this review indicates that additional quantitative measures of wetland function are required for an adequate ERA, additional field samples will be proposed in a supplemental work plan.

13. EXPOSURE ASSESSMENT: AMERICAN ROBIN

In response to EPA Comment No. 86, the exposure model for the Robin will be reevaluated and appropriate modifications made to the final ERA, including either increasing the percentage of earthworms in the diet while omitting plant foods as a factor, applying a soil-to-plant food bioaccumulation factor (BAF) to complete this food chain pathway, or another appropriate revision.

14. EXPOSURE ASSESSMENT: FISH EATERS

In response to EPA Comment No. 87, the explanation provided in the response document will be incorporated into the ERA.

15. RISK CHARACTERIZATION: SEDIMENTS

In response to EPA Comment No. 88, the ERA will be modified to include a more complete presentation of exceedences of ER-Ls as well as ER-Ms in tabular and text form, and will include a risk characterization which addresses COC-specific HQs and appropriate aggregate HIs, based on both the ER-L and ER-M NOAA guidelines, acknowledging that although these are intended only as guidelines and not as regulatory criteria, EPA Region I generally uses these guidelines to calculated HQs/HIs.

16. RISK CHARACTERIZATION: MINK, SMALL MAMMALS, AND BIRDS

In response to EPA Comment No. 90, the ERA will be modified in the following manner:

a. Aggregate HIs, with uncertainties stated, will be calculated where appropriate.

b. HQs will be calculated for all COC/species pairings for which appropriate endpoint data are available, including those not presented in the initial report (e.g., pesticides and metals for mink, all pesticide/metal COCs for hawks, 11 pesticides and 5 metals for robins at the Site 09 landfill.

c. The exposure of all indicator species to all zones in which they may feed will be addressed, including, for example, mink in the Allen Harbor landfill and other terrestrial habitats adjacent to the streams for which mink fish consumption was modeled.